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ABSTRACT

This monograph reviews and analyzes a set of treatment procedures exemplifying a positive or nonaversive approach to the amelioration of severe behavior problems in persons with developmental disabilities. Target behaviors include self-injury, aggression, and tantrums. Approximately 100 research articles drawn from 21 journals and a number of books and literature surveys are included. Specific interventions discussed include differential reinforcement of other behavior (DRO), differential reinforcement of incompatible behavior (DRI), skills acquisition, and stimulus-based treatments. Assessment and evaluation issues are discussed with respect to initial treatment effects and also in relation to stimulus generalization, response generalization, and maintenance. Variables found to be peripheral included gender, diagnosis, age, degree of retardation, and treatment setting. Variables that appeared to be central included extrinsic and intrinsic positive and negative reinforcers, and antecedent factors. Skills acquisition and stimulus-based interventions were found to be superior overall to DRO and DRI. (Over 200 references) (JDD)

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Edward G. Carr
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Monograph of The Association for Persons with Severe Handicaps
Monograph No. 4

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Positive Approaches to the Treatment of Severe Behavior Problems in Persons with Developmental Disabilities: A Review and Analysis of Reinforcement and Stimulus-Based Procedures

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Foreword

Wayne Sailor
San Francisco State University

The material in this monograph puts to rest once and for all the often repeated sentiment that while positive approaches to the management of difficult behavior are nice in theory, there is simply no demonstrated technology for use with severe behavior problems. Edward Carr and his colleagues could have settled simply for providing a timely and comprehensive review of the literature in support of the above assertion, but they have chosen instead to provide a much more valuable contribution with this seminal work. The authors have created a conceptual framework for the advancing field of positive behavior management that not only places the various strategies and tactics in relational perspective to one another, but also supplies the reader with a model with which to analyze examples of severe behavior disorder and to generate solutions from the analysis that will have a high probability of success.

Carr and his colleagues have described the heart of this conceptual framework in numerous publications; in this monograph it is fully elaborated in terms of functional analysis. Functional analysis is predicated on a general assumption of behavioral pragmatism; that is, that we behave for reasons of adaptation to the changing circumstances of our environment. We are not static organisms, but part of a dynamic, ongoing system—an ecology. Since there is a tendency toward order in the universe, so our ongoing adaptations within our ecosystems will show and reflect patterns of order and predictability. Thus, these adaptations can be isolated or segmented and specified as hypotheses for study and testing.

The conceptual framework developed here is consistent with that adopted by generic practitioners of behavioral science. Yet, a different picture emerges when one examines the history of management of difficult behavior. It is very much a history of "treat the symptom and ignore the disease." To suggest the use of shock, ammonia, mist, and other aversives as solutions to the social problems presented by behavior disorder represents an unnecessarily extreme set of tactics.

If we choose to consider why a problem behavior occurs, then a variety of potential solutions begin to emerge from the background. If we functionally analyze a severe behavior disorder, then we seek to intervene in the social ecosystem of the individual to solve the problem, rather than attack the symptom directly.

Here is a question to ponder as you read the pages to follow: What do the processes of deinstitutionalization and the development of positive behavior management strategies have in common? The answer may be that both processes focus increasingly on the issue of social ecology. Perhaps, therefore, the time has come to examine this issue within the context of functional analysis. In all probability, the treatment setting will become of interest to the social scientist as the independent variable in the further study of positive social change for people with disabilities.

Carr, E.G., Robinson, S., Taylor, J.C., & Carlson, J.I. (1990). *Positive approaches to the treatment of severe behavior problems in persons with developmental disabilities: A review and analysis of reinforcement and stimulus-based procedures* (Monograph No. 4). Seattle: The Association for Persons with Severe Handicaps.

The positive approach to treating severe behavior problems involves the use of interventions that are designed to make socially desirable responses more probable. As these responses become more probable, challenging behaviors including aggression, self-injury, tantrums, and property destruction become less probable. These effects are documented in a review of close to 100 research articles drawn from 21 journals and a large number of books and surveys of the literature. The positive approaches reviewed fall into two broad categories: those that are reinforcement based and those that are stimulus based. Assessment and evaluation issues are discussed not only with respect to initial treatment effects but also in relation to stimulus generalization, response generalization, and maintenance. The central notion of the monograph is that effective treatment ultimately depends on a thorough understanding of the variables that control severe behavior problems. Therefore, functional analysis provides a unifying theme for the field across research, educational, and clinical perspectives.

S

I. INTRODUCTION

The purpose of this monograph is to review and analyze a set of treatment procedures that are generally recognized as exemplifying a positive or nonaversive approach to the amelioration of severe behavior problems in persons with developmental disabilities. Although the technological aspects of treatment will be reviewed in some detail, the central theme of this monograph, one that we have intimated elsewhere as well (Carr, Robinson, & Palumbo, in press), is that effective treatment ultimately depends on a thorough understanding of the variables that control severe behavior problems. A motor without a steering wheel is a dangerous thing; so too is technology in the absence of understanding.

The content of this monograph is structured along two dimensions. Specifically, we consider treatment interventions that derive their effects primarily from the manipulation of consequences (reinforcement-based procedures) and treatment interventions that derive their effects primarily from the manipulation of antecedents (stimulus-based procedures). Assessment issues are discussed that pertain to the adequacy of both the independent and dependent variables chosen for study. Also evaluated are data pertaining to the speed of treatment effects, along with data identifying which variables are peripheral and which are central in planning treatment. Finally, we consider the impact of reinforcement and stimulus-based procedures on stimulus generalization, response generalization, and maintenance.

The theoretical framework of this monograph deserves some comment. Both the literature reviewed and the parameters selected for evaluating this literature are derived from the orientation of applied behavior analysis (Baer, Wolf, & Risley, 1968). Other orientations exist and within these orientations, different constellations of variables are emphasized. Specifically, approaches based on educational principles (Evans & Meyer, 1985), ecological/systems analysis (Landesman & Vietze, 1987), and biobehavioral considerations (Guess et al., 1988) have emerged in recent years, bringing with them new ideas for treatment and research. Notwithstanding these welcome developments, applied behavior analysis has remained an enduring approach within the field of developmental disabilities. In light of what we have just noted, we believe that it is especially timely to review the strengths and limitations of applied behavior analysis to see how far we have come and where we must go. Perhaps we then will be in a better position to appreciate what the new developments, previously mentioned, have to offer. Applied behavior analysis, like any field of inquiry, must evolve if it is to remain viable. The intent of this monograph is to help speed that evolutionary process, particularly as it pertains to the use of positive approaches to treatment.

The Nature of Positive Approaches to Treatment

The positive approach to the management of severe behavior problems focuses on interventions that are designed to make socially desirable responses more probable. As the probability of these desirable responses increases, the probability of undesirable responses (e.g., self-injury, aggression) decreases. The precise mechanisms by which the replacement of one response class by another occurs are not, for the most part, delineated in the literature, although the question is now being actively researched.

Positive approaches to treatment may be described as falling into one of two groups: those associated with manipulation of reinforcers and those associated with manipulation of discriminative stimuli.

Reinforcement-Based Treatments

Reinforcement-based treatments focus on making desirable responses more probable by arranging for reinforcement to be made contingent on these responses. There are three broad classes of reinforcement-based interventions: (a) differential reinforcement of other behavior (DRO), (b) differential reinforcement of incompatible behavior (DRI), and (c) skills acquisition.

Differential Reinforcement of Other Behavior (DRO)

This procedure initially was developed in the context of basic animal learning research. In the prototypical laboratory experiment, a pigeon is first taught to peck a key (translucent disc) in order to receive food reinforcement dispensed by automated equipment. Once key pecking has been established, reinforcement is given whenever a specified period of time has elapsed in which any behavior *other* than key pecking has occurred, hence the term differential reinforcement of other behavior (DRO). The effect of DRO is to reduce markedly the frequency of the key-pecking response. Since the DRO procedure was first systematically investigated and introduced into the basic research literature (Reynolds, 1961), there have been numerous studies replicating its response reductive effects in both animals (e.g., Carr & Reynolds, 1974; Nevin & Shettleworth, 1966; Zimmerman, Hanford, & Brown, 1967) and humans (e.g., Baer, Peterson, & Sherman, 1967; Goetz, Holmberg, & LeBlanc, 1975).

The extension of DRO to the treatment of severe behavior problems has been a feature of behavioral intervention for the past 25 years. Consider the treatment of self-injurious head-banging by means of DRO. First, an appropriate reinforcer would be selected. Typically, the reinforcer would involve highly preferred foods, which might in turn be accompanied by a social reinforcer such as praise. Next, a DRO interval would be specified. The interval is likely to be quite brief, perhaps 10 to 15 s in duration. Finally, the contingency is operationalized. Thus, it might be stated that the individual will receive a favorite food plus praise for any response that occurs after 10 s have elapsed in which there is no head-banging. If self-injury occurs before the 10 s have elapsed, the interval is reset to zero. That is, self-injury causes a further delay of reinforcement. There are, of course, many variations on this basic procedure. For example, some clinicians gradually increase the length of the DRO interval as the individual improves. In this manner, the rate of reinforcer delivery drops and the treatment becomes less costly in terms of time and personnel involved.

It is believed that DRO produces its reductive effect because a wide variety of desirable responses occurring at the end of the time interval are reinforced and, as these responses become more frequent over successive DRO intervals, they compete with and eventually replace undesirable behavior. Although this hypothesis is plausible on theoretical grounds, no one has yet demonstrated that it is true empirically.

Differential Reinforcement of Incompatible Behavior (DRI)

In DRI, an alternative behavior is chosen that is physically incompatible with the problem behavior. For example, if a young boy is observed to slap himself in the face repeatedly, he may be taught to draw pictures on a piece of paper. As long as both of his hands are in contact with the paper and the crayon is being moved across the surface of the paper, the child receives reinforcement on an intermittent basis. It is obvious from this example that the behavior of drawing pictures is physically incompatible with face-slapping; therefore, increases in the frequency of drawing will necessarily produce decreases in the frequency of self-injury.

Skills Acquisition

In the skills acquisition approach to treatment, the responses that are reinforced are those seen as enhancing the individual's ability to perform competently in the daily living environment. The approach differs from DRO in that the response to be reinforced is directly specified ahead of time, whereas in DRO any response that occurs at the end of the DRO interval is reinforced and the response cannot therefore be specified in advance. The approach also differs from DRI in that there is an emphasis on strengthening behavior that is likely to enhance individual and social competence; in DRI the focus is on choosing responses that are physically incompatible with problem behavior whether or not those responses enhance competence. Four types of skills acquisition procedures, directly relevant to dealing with severe behavior problems, can be identified from the published literature: (a) compliance training, (b) self-management, (c) differential reinforcement of communicative behavior, and (d) functional independence training.

Compliance training. The alternative response reinforced in compliance training consists of responding correctly to a variety of commands. For example, an individual may be given a series of simple commands such as "come here," "sit down," or "stand up." When the individual complies, he or she receives a reinforcer. The rationale for expecting compliance training to produce a reduction in behavior problems is not made clear in the literature. One plausible hypothesis, however, is that for most individuals, especially children, reinforcement is seldom forthcoming following compliance unless compliance occurs in the absence of behavior problems (Russo, Cataldo, & Cushing, 1981). For example, a mother will not praise her child for complying to a command such as "come here" if the child is screaming as he or she approaches the mother. Thus, most children have a personal history in which compliance and behavior problems constitute mutually exclusive response classes. Although this history of reinforcement explanation is appealing at a theoretical level, no investigator has yet demonstrated its validity empirically.

Self-management. Self-management involves up to three component skill areas, each of which can be conceptualized as an alternative response with respect to problem behavior. The first component, self-monitoring, consists of teaching the individual to discriminate appropriate versus inappropriate behaviors and to label them as such (e.g., "I made my lunch" versus "I hit myself in the face"). The second component, self-evaluation, consists of labeling a behavior as desirable versus undesirable. For example, immediately after making lunch, the client might be taught to say "I did a good job." In contrast, after face-hitting, the client might be taught to say "I didn't do a good job." The third component, self-reinforcement, consists of teaching the client to deliver reinforcers (e.g., tokens or points that can in turn be traded in for a variety of reinforcing activities) to himself or herself following a positive self-evaluation but not after a negative self-evaluation. Essentially, the client is being taught to positively reinforce

desirable response alternatives to the problem behavior. However, the rationale for why one would expect these particular response alternatives to interfere with and eventually reduce problem behavior is not articulated in the literature.

Differential reinforcement of communicative behavior (DRC). This approach is designed to deal with behavior problems that are maintained by positive and negative reinforcement variables. It is important to understand that these two sets of variables are categories, each of which contains many subcategories. Thus, the positive reinforcement variables that control behavior problems include a great variety of social, tangible, and activity events. The negative reinforcement variables that control behavior problems include a great variety of aversive events such as those relating to frustration, boredom, or stressful social interaction.

The core idea underlying DRC is the notion that some, but certainly not all, behavior problems can be profitably viewed as a nonverbal form of communication (Carr, 1985; Carr & Durand, 1985a; Donnellan, Mirenda, Mesaros, & Fassbender, 1984; Neel et al., 1983; Reichle & Yoder, 1979). This idea draws support from the literature in developmental psychology (e.g., Bell & Ainsworth, 1972; Brownlee & Bakeman, 1981; Wolff, 1969) as well as developmental disabilities (e.g., Shodell & Reiter, 1968; Talkington, Hall, & Altman, 1971). Through functional analysis procedures, it is sometimes possible to identify the pragmatic intent (see Bates, Camaioni, & Volterra, 1975; Leung & Rheingold, 1981) of the behavior problem; that is, whether the problem is a request for positive reinforcement (e.g., food, attention, preferred activities) or negative reinforcement (e.g., task cessation, termination of social interaction). When the analysis identifies a specific request function, new (nonproblematic) forms of requesting can be taught to replace the problem behavior (Carr, McConnachie, Levin, & Kemp, in press). For example, if an individual is headbanging ostensibly to gain attention from others, that individual could be taught to request attention through more common linguistic means; for example, by tapping the other person on the shoulder, by signing the person's name, or by speaking to the other person. Recent data demonstrate that more general training in communication skills can also produce reductions in behavior problems (Hunt, Alwell, & Goetz, 1988; Koegel, Koegel, Murphy, & Ryan, 1989).

Functional independence training. This strategy involves training a variety of socially useful behaviors such as leisure skills, vocational skills, and self-help skills. The literature does not make clear why this strategy should be effective in reducing behavior problems. It is plausible, though, that a reinforcement competition hypothesis may be relevant. That is, the natural reinforcers that follow a variety of socially useful behaviors are hypothesized to be more powerful than those that follow aberrant behavior. Therefore, the individual engages in greater levels of desirable behaviors and these eventually replace the aberrant behaviors.

Stimulus-Based Treatments

Stimulus-based treatments focus on making desirable responses more probable by arranging for stimuli that control nonproblematic behavior to be presented more often, or by altering stimuli that control high rates of behavior problems so that they no longer do so, but instead evoke nonproblematic behavior. The literature on stimulus-based treatments is small but growing. Five stimulus-based intervention strategies are discussed here in order to give some indication of the direction of this emerging technology.

Introduce Stimuli That Control Low Rates of Behavior Problems

In this procedure, a detailed observational assessment is made initially in order to identify situations and settings that are correlated with low rates of behavior problems. Thus, it may be found that behavior problems are rare in the presence of certain group home staff members or that problems seldom occur during particular activities such as physical education or supported employment. The strategy then becomes one of rescheduling staff and activities, most often temporarily, in order to multiply the individual's exposure to those situations and settings that are correlated with low rates of behavior problems.

Modify Stimuli That Control High Rates of Behavior Problems

In this strategy, those stimuli that most often evoke behavior problems are first identified. For example, direct observation may indicate that the presentation of difficult instructional demands reliably produces self-injury and aggression in a particular individual. The next step involves modifying the offending stimulus to reduce problem behavior. In the example given, one might break the difficult task into smaller and more manageable components, thereby mitigating frustration and failure. The modified stimulus now no longer evokes self-injury and aggression.

Embed Stimuli That Control High Rates of Behavior Problems Among Those That Control Low Rates of Behavior Problems

Again, one may find that some stimuli such as instructional demands reliably evoke behavior problems, whereas

other stimuli such as those comprising a conversational exchange on a topic of interest do not. The embedding strategy could involve occasionally presenting the offending stimuli (difficult demands) in the context of a positive conversational exchange. This strategy can attenuate the influence of the offending stimuli and produce a decrease in problem behavior. Furthermore, the strategy is worthwhile because it allows continued presentation of stimuli (e.g., instructional demands) that may be crucial for producing normalized functioning.

Modify Educational Curricula Associated with Behavior Problems

Some educational curricula may be observed to be correlated with high rates of behavior problems. For example, one may find that devoting an entire instructional session to a single task (e.g., labeling) is associated with many behavior problems. In contrast, teaching a variety of tasks (e.g., labeling, self-help skills, and concept acquisition) within the same instructional session may be associated with few behavior problems. If so, educational curricula can be modified to maximize varied teaching and minimize repetitive teaching. Curricular change, in this instance, may constitute a treatment for severe behavior problems.

Ameliorative Use of Setting Events

Setting events is the term given to a broad category of variables that affect preexisting stimulus-response relationships (Bijou & Baer, 1978; Wahler & Fox, 1981; Wahler & Graves, 1983). Consider a young boy who likes eating cookies. Every time he sees a cookie, he asks for one. Thus, there is a strong association between a stimulus (sight of the cookie) and a response (requesting the cookie). One day he fails to make the request in spite of the fact that cookies are present. Upon investigation we may find that he is not hungry today because someone just gave him ten cookies. Alternatively, we may find that he has a stomach flu. Or, we may find that he is more interested in the presence of a powerful competing activity, perhaps a video game, that has suddenly become available. Hunger, illness, and competing activities constitute a few examples of the many events that can alter preexisting stimulus-response relationships. There is a growing interest in identifying setting events that can be used to alter those stimulus-response relationships that involve behavior problems. It is thought that behavior problems can be reduced by manipulating such setting events.

Here is one example of how setting events might be used to effect behavior change: A young boy diagnosed as retarded regularly becomes self-injurious (the response) whenever he is subjected to a dental examination (the stimulus). Given this problem, a treatment protocol is designed in which the child is permitted to become familiar with the examination room and dental instruments over a period of days and is given relaxation exercises shortly before the examination. It is found that the combination of familiarization and relaxation constitutes a setting event that alters the preexisting stimulus-response relationship. Specifically, the introduction of the setting event results in the elimination of self-injury as a response to the dental examination even though the offending stimulus itself (i.e., the dental examination) remains unchanged.

II. INCLUSION CRITERIA FOR STUDIES EXAMINED

Target Behaviors

Severe behavior problems are defined as those involving self-injury, aggression, and tantrums. Self-injury includes but is not limited to head-banging, self-biting, self-scratching, self-punching, eye-gouging, trichotillomania, pica, and rumination. Aggression includes violent acts directed against other people and against property. Tantrums include instances of yelling, crying, and whining that occur singly or in combination over a period of time and with great intensity. We did not review the literature on self-stimulation unless it was clear that such behavior produced measurable tissue damage. We did not review the literature on mild disruption, including but not limited to out-of-seat behavior, nagging, teasing, showing off, or swearing, nor did we review material concerning stealing or anorexia. Finally, encopresis was excluded from the review unless the behavior was accompanied by rectal digging.

Literature Reviewed

Table 1 presents the complete list of sources from which we drew studies for analysis. Two sources were used: (a) journals and (b) review papers and books. In addition, we incorporated information provided by the National Institutes of Health from the National Library of Medicine MEDLINE search on the literature pertaining to self-injurious and aggressive behavior.

We rejected from our pool of studies those papers that

Table 1
Sources Used to Identify Studies Involving Reinforcement and Stimulus-Based Treatments for Severe Behavior Problems in Developmental Disabilities

Journals reviewed
- American Association for the Education of the Severely/Profoundly Handicapped Review (1976-1979)
- American Journal of Mental Deficiency (1960-1987)
- American Journal on Mental Retardation (1987-1989)
- Analysis and Intervention in Developmental Disabilities (1981-1986)
- Applied Research in Mental Retardation (1980-1986)
- Behavior Modification (1977-1989)
- Behaviour Research & Therapy (1963-1989)
- Behavior Therapy (1970-1989)
- Child Behavior Therapy (1979-1981)
- Child and Family Behavior Therapy (1982-1989)
- Education and Training of the Mentally Retarded (1966-1989)
- Education and Treatment of Children (1977-1989)
- Journal of Applied Behavior Analysis (1968-1989)
- Journal of The Association for Persons with Severe Handicaps (1983-1989)
- Journal of Autism and Developmental Disorders (1971-1989)
- Journal of Behavior Therapy and Experimental Psychiatry (1971-1989)
- Journal of Consulting and Clinical Psychology (1960-1988)
- Journal of Experimental Child Psychology (1962-1989)
- Journal of the Multihandicapped (1988-1989)
- Mental Retardation (1963-1989)
- Research in Developmental Disabilities (1987-1989)

Review papers and books
- Albin (1977)
- American Medical Association (1987)
- Bachman (1972)
- Bates & Wehman (1977)
- Baumeister & Rollings (1976)
- Berkson & Landesman-Dwyer (1977)
- Carr (1977)
- Davis & Cuvo (1980)
- Donnellan, Mirenda, Mesaros, & Fassbender (1984)
- Evans & Meyer (1985)
- Favell, Azrin, Baumeister, Carr, Dorsey, Forehand, Foxx, Lovaas, Rincover, Risley, Romanczyk, Russo, Schroeder, & Solnick (1982)
- Frankel & Simmons (1976)
- Fulcher (1984)
- Gardner & Cole (1984)
- Gorman-Smith & Matson (1985)
- Guess, Helmstetter, Turnbull, & Knowlton (1987)
- Harris & Ersner-Hershfield (1978)
- Hollis & Meyers (1982)
- Homer & Peterson (1980)
- Johnson & Baumeister (1978)
- LaGrow & Repp (1984)
- LaVigna & Donnellan (1986)
- LaVigna, Willis, & Donnellan (1989)
- Lennox, Miltenberger, Spengler, & Erfanian (1988)
- Lundervold & Bourland (1988)
- Maisto, Baumeister, & Maisto (1978)
- Matson & DiLorenzo (1984)
- Matson & Gorman-Smith (1986)
- Matson & Taras (1989)
- Mulick & Kedesdy (1988)
- Murphy & Wilson (1985)
- Picker, Poling, & Parker (1979)
- Poling & Ryan (1982)
- Schroeder, Bickel, & Richmond (1986)
- Schroeder, Mulick, & Rojahn (1980)
- Schroeder, Rojahn, Mulick, & Schroeder (in press)
- Schroeder, Schroeder, Rojahn, & Mulick (1981)
- Singh (1981)
- Smolev (1971)
- Snell & Beckman-Brindley (1984)
- Starin & Fuqua (1987)
- Voeltz & Evans (1982)
- Voeltz & Evans (1983)

were purely anecdotal, as well as foreign language papers. Also, we did not review studies that involved individuals who were nonhandicapped or individuals with handicaps, but who were not developmentally disabled. We eliminated several nonexperimental studies in which treatment effects were reported only as group means, thereby making it impossible to determine how any one individual responded to a treatment. Finally, inclusion criteria involved certain considerations pertaining to methodological adequacy and the use of combinations of treatments. These issues are discussed in later sections of the monograph.

Methodological Adequacy

The evaluation of treatment effectiveness is typically made using a variant of either the reversal design (ABAB) or the multiple baseline design (Hersen & Barlow, 1976). In the typical reversal design, a baseline (BL) or A condition is alternated with a treatment or B condition. Consider the reversal design employed in a study of self-injury conducted by Rose (1979). In the initial baseline (A) condition, the child bit herself at the rate of 1.04 responses per min. When the DRO treatment (B) condition was introduced, the rate of hand-biting fell to .07 responses per min. When the child was returned to the baseline condition, the downward trend in her self-injury reversed, and she exhibited .43 responses per min. Reinstatement of the DRO treatment once again caused a decrease in the rate of self-biting to .05 responses per min. Since the systematic application and removal of the treatment intervention (independent variable) produced systematic changes in the level of self-injury, experimental control (internal validity) was demonstrated.

In the multiple baseline design, treatment is introduced after baselines of varying lengths have been taken across a number of settings and/or responses and/or treatment agents and/or subjects. Consider the multiple baseline across settings design used to evaluate the DRO treatment of self-biting in a study by Luiselli, Helfen, Colozzi, Donellon, & Pemberton (1978). Baselines of progressively greater lengths were taken in three consecutive instructional settings; namely, language, prewriting, and shoe-tying. The mean rate of self-biting was .42 responses per min during baseline in the language setting. When DRO was introduced into that setting, the mean rate of self-biting decreased to .04 responses per min. Meanwhile, self-biting remained high in the prewriting and shoe-tying settings in which DRO had not yet been introduced. When it was introduced into the prewriting setting, self-biting decreased from a baseline level of .16 responses per min to .01 responses per min. At the same time that self-biting decreased in the prewriting setting, it remained high in the shoe-tying setting. When DRO was finally introduced into that setting as well, self-biting decreased from a baseline level of .20 responses per min to only .02 responses per min. The logic of the multiple baseline design across settings is that a decrease in behavior problems should occur only when treatment is systematically introduced into a specific setting and not before. When this outcome is obtained, as it was in the Luiselli et al. (1978) study, experimental control (internal validity) is demonstrated (Baer et al., 1968). A similar logic applies to the use of the multiple baseline design across treatment agents, across responses, and across subjects.

Table 2 lists the specific empirical studies examined that dealt with DRO, DRI, skills acquisition, and stimulus-based intervention, including the various subcategories of the latter two treatment strategies. The vast majority of the studies listed used a variant of either the reversal or multiple baseline design. Studies in which the treatment of at least one individual was evaluated with an appropriate experimental design are indicated with an asterisk. Studies that do not have an asterisk used nonexperimental designs and therefore must be interpreted conservatively. All the studies did, however, provide baseline data. Studies not providing baseline data were eliminated from further consideration, since they did not permit meaningful treatment evaluation. Also, a handful of studies reported data based on groups of subjects in which different subjects received different treatments. However, the studies did not make clear which subjects received which treatments. Because interpretation of treatment effects was therefore not possible, these studies also were excluded from further consideration.

The majority of studies listed in Table 2 involves a small *N*, often as few as one or two subjects. This feature is typical of most behavior modification research and probably reflects the intensive, time-consuming nature of treatment, the lack at any one facility of large groups of individuals showing severe behavior problems, the extreme heterogeneity of the population that makes matched comparisons and more traditional control group designs difficult to arrange, and ethical considerations that make it unacceptable to delay treatment (e.g., waiting list control) for individuals showing dangerous behavior problems. Of course, the use of small *N* designs makes statements concerning the external validity of treatment procedures somewhat uncertain. Nonetheless, generality is demonstrated when an intervention is successful across a wide variety of age groups, diagnostic categories, treatment settings, and target behaviors. In other words, the issue of generality is addressed by noting the systematic replication (Sidman, 1960) of clinical effects across a cumulative body of research studies.

Table 2
Studies Reviewed in the Evaluation of Positive Procedures

DRO
- * Altman & Krupshaw (1983)
  Anderson, Dancis, & Alpert (1978)
- * Augustine & Cipani (1982)
- * # Azrin, Besalel, Jamner, & Caputo (1988)
- * # Barman (1980)
- * # Conrin, Pennypacker, Johnston, & Rast (1982)
- * # Corte, Wolf, & Locke (1971)
- * # Deitz, Repp, & Deitz (1976)
  Dorsey, Iwata, Ong, & McSween (1980)
- * Foxx & Shapiro (1978)
  Frankel, Moss, Schofield, & Simmons (1976)
- * Friman, Barnard, Altman, & Wolf (1986)
- * Garcia & DeHaven (1975)
  # Lockwood & Bourland (1982)
- * Luce, Delquadri, & Hall (1980)
- * # Lucero, Frieman, Spoering, & Fehrenbacher (1976)
- * Luiselli (1984)
  Luiselli (1988)
- * # Luiselli, Colozzi, & O'Toole (1980)
- * # Luiselli, Helfen, Colozzi, Donellon, & Pemberton (1978)
- * # Luiselli, Myles, Evans, & Boyce (1985)
- * Luiselli, Myles, & Littman-Quinn (1983)
- * # Luiselli & Reisman (1980)
- * Luiselli & Slocumb (1983)
  Luiselli, Suskin, & Slocumb (1984)
- * Mulick, Schroeder, & Rojahn (1980)
  Myers (1975)
- * Neufeld & Fantuzzo (1987)
- * # Parrish, Cataldo, Kolko, Neef, & Egel (1986)
- * Poling, Miller, Nelson, & Ryan (1978)
  Polvinale & Lutzker (1980)
  Rapoff, Altman, & Christophersen (1980)
- * Repp, Barton, & Brulle (1983)
- * # Repp, Deitz, & Deitz (1976)
- * Rolider & Van Houten (1985)
- * # Rose (1979)
- * Singh & Pulman (1979)
- * Sisson, Van Hasselt, Hersen, & Aurand (1988)
- * Tarpley & Schroeder (1979)
- * # Weiher & Harman (1975)

DRI
- * # Azrin, Besalel, Jamner, & Caputo (1988)
  # Friman, Barnard, Altman, & Wolf (1986)
- * Gaylord-Ross, Weeks, & Lipner (1980)
- * Luiselli (1984)
  # Mace, Kratochwill, & Fiello (1983)
  Measel & Alfieri (1976)
- * Mulick, Schroeder, & Rojahn (1980)
- * Neufeld & Fantuzzo (1987)
  # Saposnek & Watson (1974)
- * Smith (1987)
- * # Steege, Wacker, Berg, Cigrand, & Cooper (1989)
  # Steen & Zuriff (1977)
- * # Tarpley & Schroeder (1979)
- * Young & Wincze (1974)

Skills acquisition

DRC
- * # Billingsley & Neel (1985)
- * # Carr & Durand (1985a)
- * Carr, Newsom, & Binkoff (1980)
- * # Casey (1978)
  # Day, Rea, Schussler, Larsen, & Johnson (1988)
- * # Durand & Kishi (1987)
- * # Horner & Budd (1985)

Compliance
- * Brawley, Harris, Allen, Fleming, & Peterson (1969)
- * Cataldo, Ward, Russo, Riordan, & Bennett (1986)
- * # Parrish, Cataldo, Kolko, Neef, & Egel (1986)
- * # Russo, Cataldo, & Cushing (1981)
- * # Schneider, Ross, & Dubin (1979)
- * # Slifer, Ivancic, Parrish, Page, & Burgio (1986)

Self-management
- * # Gardner, Cole, Berry, & Nowinski (1983)
- * # Shapiro & Klein (1980)

Functional independence
- * # Azrin, Jamner, & Besalel (1986)
- * # Bryant & Budd (1984)
- * # Lovaas, Freitag, Gold, & Kassorla (1965)

Stimulus-based treatments

Introduce stimuli that control low rates of behavior problems
- * # Touchette, MacDonald, & Langer (1985)

Modify stimuli that control high rates of behavior problems
- * Hughes & Davis (1980)
- * # Weeks & Gaylord-Ross (1981)

Embedding
- * # Carr, Newsom, & Binkoff (1976)

Modify educational curricula
- * # Altman, Hobbs, Roberts, & Haavik (1980)
- * # Winterling, Dunlap, & O'Neill (1987)

Use of setting events
- * # Ball, Hendricksen, & Clayton (1974)
- * Baumeister & MacLean (1984)
- * # Carr & Newsom (1985)
- * Carr, Newsom, & Binkoff (1980)
  Dorsey, Iwata, Reid, & Davis (1982)
- * # Dura, Mulick, & Hammer (1988)
- * # Favell, McGimsey, & Schell (1982)
  Gordon, Handleman, & Harris (1986)
- * Jackson, Johnson, Ackron, & Crowley (1975)
- * # Jansma & Combs (1987)
- * # Lancioni, Smeets, Ceccarani, Capodaglio, & Campanari (1984)
- * Lobato, Carlson, & Barrera (1986)
  # Rast & Johnston (1986)
- * # Rast, Johnston, Drum, & Conrin (1981)
- * Rojahn, Mulick, McCoy, & Schroeder (1978)
- * # Silverman, Watanabe, Marshall, & Baer (1984)
  # Thomas & Howard (1971)
- * # Wells & Smith (1983)

* Indicates acceptable experimental design
# Indicates that study includes at least one subject who was a treatment success

III. ASSESSMENT ISSUES

Need for Measures of Severity

In the published literature, behavior problems typically are assessed using measures of frequency, rate, or duration. Unfortunately, these measures tell little or nothing about the severity or intensity of the problem. Thus, 50 low amplitude head-bangs per day may be less a problem than a single high amplitude head-bang once per month that results in hospitalization. The field has not yet resolved the issue of how to measure low frequency but high intensity behavior problems. More generally, attempts to quantify the severity of behavior problems from the published literature have been frustrating. No studies have been reviewed in which a reliable, valid instrument was used to assess severity. Instead, a few studies have reported anecdotal observations such as weight loss (Barman, 1980), or abrasions following self-biting (Luiselli et al., 1978), or bruising others through aggressive acts (Luiselli, Myles, Evans, & Boyce, 1985). Since severity of behavior problems is often as great a clinical concern as frequency, the field must begin to develop instruments designed to measure this dimension of behavior as well.

Need for Measures of Treatment Fidelity

As noted earlier, a great deal of attention has been paid to assessing various aspects of the dependent variable; namely, frequency, rate, and duration of behavior problems. Unfortunately, there has not been a parallel emphasis on assessing the integrity of the independent variable (i.e., procedural reliability or treatment fidelity). A substantial number of published articles do not report data confirming that the treatment occurred as described and many papers do not report operational definitions that identify the specific characteristics of the treatment procedures used, omissions that impede replication efforts (Peterson, Homer, & Wonderlich, 1982; Voeltz & Evans, 1983). The absence of treatment fidelity measures in studies reporting failure raises the possibility that treatment was inconsistently or incompetently applied. Furthermore, when procedures previously demonstrated to be effective are not replicated, it is important to examine how well the original procedures were operationalized and whether later investigators were in fact applying procedures similar to those in earlier studies. Of course, treatment failure may in fact indicate that an intervention has little or no clinical merit. However, many positive procedures are complex in nature and may have multiple components. In this case, the issue of treatment fidelity looms large and, without an adequate assessment of whether the independent variable was applied reliably and with integrity, one cannot rule out the possibility that clinical failure is due to poor implementation rather than defects inherent in the procedure itself.

Functional Analysis

The functional analysis of behavior is a term used to refer to a method of assessment that relies on a detailed experimental analysis of the variables of which behavior is a function (Skinner, 1953, 1959). These variables can include antecedents, in which case the analysis focuses on stimulus control and setting events, and it can include consequences, in which case the analysis focuses on the positive and negative reinforcement variables that maintain the behavior. The essence of functional analysis is that it is experimental in nature. That is, assessment involves the direct manipulation of the variables thought to control the behavior.

Two examples illustrate the use of functional analysis in behavior assessment. Martin and Foxx (1973) treated a 22-year-old woman who was diagnosed as retarded. The woman exhibited high levels of aggressive behavior toward others, including behaviors such as slapping, punching, and biting. Because the investigators suspected that the woman's aggression was maintained by positive social reinforcement (i.e., attention from other adults), they experimentally manipulated (in a reversal design) the amount of attention that the woman received for her aggressive behavior. When they ignored her aggression (extinction), the frequency of the behavior decreased quickly from four attacks per 15 min evaluation during the first 10 sessions to near zero during the following 90 sessions. In the next phase, aggressive behavior was attended to by others (social reinforcement). For example, other adults would tell the woman, "Don't you ever do that again." Following this intervention, aggressive behavior increased again, eventually reaching a level of 29 attacks per session. Finally, when extinction was reinstated, the woman's aggressive behavior declined to zero after five sessions and remained there for the rest of the study. The fact that aggressive behavior increased and decreased systematically as a function of the presence or absence of social reinforcement from others established that positive reinforcement (in the form of attention) was a controlling variable for this woman's aggression.

A second example (Carr, Newsom, & Binkoff, 1980) involved the treatment of a 14-year-old boy who was diagnosed as retarded. The child exhibited high levels of aggression toward others, including behaviors such as scratching, hitting, kicking, and biting. Because previously col-

lected data showed that the child was aggressive primarily when demands were made upon him, the investigators suspected that aggression was an escape response maintained by negative reinforcement (i.e., the termination of an aversive stimulus, in this case, demands). That is, in lay terms, the child had learned to aggress in order to get out of task situations that he did not like. If this hypothesis were true, then ceasing instruction contingent on aggression should actually cause an increase in aggression, whereas continuing instruction in spite of aggression should produce a decrease in the behavior since the behavior would no longer function to extricate the child from the demand situation. These hypotheses were tested in a reversal design. When the adult first continued instruction in spite of aggression, the child's aggressive behavior fell over a period of eight 1-hr sessions to only one or two aggressive acts per session. In contrast, when the adult subsequently allowed the child to escape instruction contingent on aggression, aggressive behavior increased to 1625 aggressive acts in a 1-hr session. These effects were replicated in the later components of the reversal design. The fact that aggressive behavior increased and decreased systematically as a function of the opportunity (or lack thereof) to escape from an instructional situation established that negative reinforcement (in the form of cessation of demands) was a controlling variable for this boy's aggression.

The examples described make clear two points. First, one cannot predict which variables are important in the control of aggression simply from a knowledge of diagnosis. The woman and the boy were both diagnosed as retarded, yet the woman's aggression was systematically related to positive reinforcement variables, whereas the boy's aggression was systematically related to negative reinforcement variables. Second, knowing the topography of a behavior problem may not provide any clues to appropriate treatment. Both the woman and the boy were aggressive, yet the woman's aggression responded to removal of attention, while the boy's aggression responded to continued presentation of demands. A functional analysis of controlling variables provides the kind of information one needs for treatment planning. Traditional diagnosis and description of behavior topography do not.

For 25 years, textbooks and position papers in the field of applied behavior analysis have advised that treatments should be based on a thorough functional analysis (Baer et al., 1968; Bandura, 1969; Bellack & Hersen, 1977; Gelfand, Jenson, & Drew, 1988; Kanfer & Saslow, 1969; Kazdin, 1980; Ross, 1980; Sulzer-Azaroff & Mayer, 1977; Ullman & Krasner, 1965). Early in the development of the field, there were in fact a number of instances in which this advice was followed (e.g., Hawkins, Peterson, Schweid, & Bijou, 1966; Lovaas, Freitag, Gold, & Kassorla, 1965; Patterson, Littman, & Bricker, 1967; Wahler, 1969; Wolf, Birnbrauer, Williams, & Lawler, 1965). However, the attempt was short-lived. There has been ample documentation that functional analysis, although still widely respected and taught, has been all but abandoned in favor of purely technical interventions that are oriented toward quick suppression of behavior problems without any prior analysis of the variables controlling those problems (Deitz, 1978; Hayes, Rincover, & Solnick, 1980; Lundervold & Bourland, 1988). Of course, it can be argued from the literature that a variety of interventions have been successful in spite of the absence of functional analysis in treatment planning. This statement, however, is only partly true, since the literature also documents numerous treatment failures and weak effects. Two plausible clinical examples involving DRO and DRI respectively will suffice to indicate at a conceptual level how treatment implemented without prior functional analysis can be a pointless, if not counterproductive, exercise. Consider first the case of a boy with autism who bites himself whenever he has to urinate. A standard DRO procedure, implemented without benefit of functional analysis, might be to give the child a small glass of juice for every 5 min that elapse without any instances of self-injury. This procedure, of course, would actually exacerbate the problem by contributing to the need for urination. A functional analysis, in contrast, would have identified the relationship between self-biting and the need to urinate, thereby permitting a more rational treatment choice such as teaching the child to request toileting.

Consider next the case of a girl diagnosed as severely retarded who screams whenever she is frustrated by a difficult task. A standard DRI procedure, implemented without benefit of functional analysis, might be to teach the child to sing, because this behavior would be physically incompatible with screaming. The procedure, of course, would not address the fact the screaming is the result of task frustration. A functional analysis, in contrast, would have identified the relationship between screaming and frustration, thereby permitting a more rational treatment choice such as teaching the child to request help with the task. It is impossible to know from the literature how many failures can be attributed to improper treatment selection due to ignorance of the variables controlling the problem behavior. However, the possibility that treatment failures may be more likely in the absence of prior functional analysis has led to a renewed interest in the field in this topic. This trend is most notable during the last four to five years and has led to a small but growing literature that represents a return to the conceptual roots of applied behavior analysis.

Primacy of Conditional Probability

The most typical dependent measures assessed in a functional analysis concern frequency, rate, and duration. Increasingly, however, researchers have begun to consider these measures as incomplete and sometimes misleading. Consider a situation in which the assessment of a man's aggressive behavior uses frequency as the dependent measure. The average daily frequency of aggressive acts is determined to be 100. A closer examination reveals, however, that most of these acts take place when the individual is asked to brush his teeth. Specifically, the conditional probability of aggression given a request to brush his teeth is .98. Clearly, the conditional probability measure is more revealing from a functional analytic perspective than the measure of overall frequency. Clinically, this finding would focus subsequent treatment efforts on designing interventions to deal with a very specific situation; namely, the possibility that the problem behavior is escape-motivated and toothbrushing is an aversive event.

Conditional probability measures have been common in the literature on conduct disorders for a number of years (Patterson, 1982). However, until recently, their use in the area of developmental disabilities has been implicit; that is, they have been limited to the relatively few studies that have highlighted the role of stimulus variables in the discriminative control of behavior problems (e.g., Carr & Durand, 1985a; Touchette, MacDonald, & Langer, 1985; Winterling, Dunlap, & O'Neill, 1987). It appears that an important trend in the field concerns the gradual replacement of global frequency measures with more functionally relevant measures involving conditional probability.

IV. EVALUATION ISSUES

Treatment Effects

How Measured

As noted before, all of the studies listed in Table 2 have, at a minimum, a baseline phase and a treatment phase. Treatment effects were always measured in terms of percent reduction in behavior problems relative to baseline. In many of the studies a reversal design is used; therefore, there are often several treatment conditions that alternate with several baseline conditions. When this type of design is used, the final, rather than earlier, treatment conditions are deemed most important, since the critical question that needs to be addressed concerns how well the subject is doing by the end of treatment. Additionally, because treatment frequently produces a steady downward trend over time in the level of behavior problems, the overall mean for a treatment condition may actually underrepresent the final effect. To minimize this problem, the mean of the last three treatment sessions (when available) is used so that a judgment can be made concerning subject improvement at the termination point of a study. In those few cases in which it is not possible to determine from the data presented the mean of the last three sessions, we used the overall mean for the treatment condition of interest. In sum, treatment effects were measured as percentage reduction in behavior problems from baseline during the final three sessions (typically) of the final treatment condition.

Reliability of Computation

Many studies do not report treatment means in the text; therefore, it often was necessary to estimate these means directly from the figures provided. Since it was possible that errors of estimation could occur, a reliability computation was carried out on the measurements described in the preceding section. Five studies from each of the four treatment categories were randomly selected from the pool of 96 studies. Two people independently calculated the relevant means for all of the cases represented by the 20 studies. These data include the baseline and treatment outcome means calculated in all treatment settings. The Pearson product-moment correlation coefficient was +0.99. Reliability was statistically significant, $t(103) = 202.3$, $p < .002$.

Speed of Effect

The Issue of Crisis Management

A central issue in the management of severe behavior problems concerns the question of how quickly an intervention is able to contain a dangerous situation, that is, a crisis. In fact, a major advantage cited for the use of aversive treatment procedures relates to the speed with which these procedures suppress behavior problems. However, one extensive review of the literature in this area (Guess, Helmstetter, Turnbull, & Knowlton, 1987) notes that, across a variety of studies, aversive procedures took an average of 15 hr per subject to suppress aggression-disruption (range: .2 to 150 hr) and .9 hr per subject to suppress self-injury (range: .2 to 150 hr). Apparently, instantaneous suppression is not a general feature of aversive intervention, although some studies report very rapid suppression. Undoubtedly, crisis management is a critical topic when one deals with behaviors that pose immediate danger to an individual or to others who come in contact with that individual. However, crisis management is not the central focus of positive procedures and therefore, the speed of effect issue is, with a few exceptions noted later, largely irrelevant to evaluating these procedures.

The central focus of positive procedures, as described earlier, is on increasing the probability that socially desirable behaviors will occur and eventually replace problem behaviors. Because there is a premium placed on the sometimes arduous task of strengthening alternative responses, treatment effects often take time. Related to this fact is a methodological issue. Specifically, treatment data are sometimes reported only after a period of training has occurred. Since the duration of this training may not be readily ascertained from procedural descriptions, treatment probe data by themselves do not necessarily reflect how quickly behavior problems come under control. Notwithstanding these caveats, we will provide some indication, later in this review, of how quickly positive procedures can achieve their effects. The fact that some positive procedures may be capable of dealing quickly and effectively with crisis situations tends to undermine arguments that accord a unique role for aversive procedures in crisis management (Carr et al., in press). At this point we note simply that the goals of aversive and positive procedures may be quite different. The major goal of aversive intervention is crisis management, hence the centrality of speed of effect issues. The major goal of positive intervention is behavior replacement, hence the centrality of response selection and maintenance issues.

Relation to Positive Approaches

DRO. A study by Luiselli et al. (1985) illustrates the use of DRO to control aggression. A 15-year-old girl who was deaf and blind and diagnosed as retarded engaged in frequent slapping, punching, and scratching of others. A DRO

of 5 min was established. If the girl did not engage in aggressive behavior for the 5-min period, she was given edible and tactile reinforcement. As she improved the DRO interval was increased gradually to a maximum of 30 min. Using this regimen, the investigators demonstrated a greater than 90% suppression of aggressive behavior within four school days, a total of 24 hr of treatment.

A paper by Rose (1979) examined the use of DRO to control self-injury. A 9-year-old girl diagnosed as schizophrenic was observed to exhibit a high rate of hand-biting. A DRO 5-min schedule was established with food as the reinforcer. Intervention produced a greater than 98% decrease in self-injury within 50 min and a stable low rate within 3.3 hr of treatment.

DRI. A paper by Tarpley and Schroeder (1979) demonstrates the use of DRI to treat self-injury. One of the individuals treated in the study was an 8-year-old boy who had a diagnosis of Down syndrome. The child engaged in face-slapping and face-punching. A DRI of 30 s was employed in which the child was required to engage in a behavior that was physically incompatible with the self-injury. Specifically, he had to play with a ball for 30 s at a time without exhibiting self-injury after which he would receive a food reward. This intervention resulted in a greater than 90% decrease in self-injury within 40 min.

Mace, Kratochwill, and Fiello (1983) worked with a 19-year-old young man diagnosed as mentally retarded. This individual exhibited severe tantrums. Eating ice cream was the response chosen as being physically incompatible with tantrum behavior, a response that clearly had its own built-in reinforcer. With this treatment, total suppression of tantrums was observed within 10 min.

Skills acquisition. A study by Russo et al. (1981) examined the use of compliance training to control self-injury and aggression. One of the children who was treated was 3.5 years old with an IQ in the retarded range. This boy engaged in self-inflicted head-banging and hand-biting, as well as kicking and biting others. The child was taught simple compliance skills in response to commands such as "come here" or "sit down." Appropriate compliance was reinforced with a variety of foods as well as verbal praise and physical contact. Behavior problems declined by more than 90% of the baseline level within 40 min (4 sessions) in the presence of one therapist and within 10 min (1 session) in the presence of a second therapist.

Carr & Durand (1985a) trained specific communication skills in order to control aggression, tantrums, and self-injury in four children ranging in age from 3 to 6 years and having varying diagnoses of autism, brain damage, and developmental delay. Each child first was taught a phrase that served the same function as the behavior problem it was to replace. Thus, behavior problems motivated by attention-seeking were treated by teaching the child to solicit attention verbally from the teacher (e.g., asking an adult, "Am I doing good work?"). Following a period in which the communication skill was trained, each child showed greater than 90% suppression of behavior problems within 10 to 20 min (i.e., 1 or 2 sessions).

Stimulus-based treatments. A paper by Touchette et al. (1985) illustrates the use of stimuli correlated with low rates of behavior problems as a means to control those problems. One of the individuals treated was an 18-year-old young woman diagnosed as autistic. She engaged in a variety of aggressive behaviors, including hitting, kicking, and head-butting. Certain activities were identified that were correlated with low rates of behavior problems. When these activities were substituted for others that had been associated with many behavior problems, the number of assaults decreased by more than 90% within the first day of treatment.

Winterling et al. (1987) demonstrated the use of curriculum changes to control aberrant behavior. Three individuals, ages 5, 12, and 20 years, all diagnosed as autistic, participated. Initially, the investigators demonstrated that teaching a single task, repetitively, within individual sessions was associated with high rates of aggression and tantrums. When the curriculum was changed so that a variety of tasks were taught within sessions, behavior problems decreased dramatically. Specifically, there was a greater than 90% decrease in aggression and tantrums for all three children within 10 to 15 min (one treatment session).

Conclusion. The studies cited suggest that there are many instances in which positive interventions can produce effects that are as rapid as those reported in the literature on aversives. However, several qualifications are in order. First, as will be noted later, there are many studies involving the use of positive interventions in which there are no treatment effects or the effects are weak. Obviously, for these studies, speed of effect is not a relevant issue. However, there is a more important qualification noted earlier. Specifically, the true significance of positive approaches lies in their focus on replacing behavior problems with other, more desirable behavior. This focus often necessitates periods of training (e.g., in communication, self-management) that generally occur when the individual is not engaging in problem behaviors (i.e., when there is no crisis). Thus, speed of effect is more generally relevant to the literature on aversives than to the literature on positive interventions. The major exception to this statement, and one that questions the necessity for aversives, involves the use of stimulus-based interventions, which by their nature are likely to produce quick behavior change.

Combination Treatments

Interpretive Problems

Positive procedures are sometimes combined with aversive procedures in order to produce treatment "packages." Studies employing this strategy pose major problems in interpretation. Consider a study by Repp & Deitz (1974) in which DRO was combined with response cost (loss of token reinforcers contingent on behavior problems) and verbal reprimands in order to treat successfully the aggressive behavior of a 13-year-old boy diagnosed as mentally retarded. Overall, the combination treatment suppressed aggressive behavior to negligible levels, a highly desirable clinical outcome. However, from an evaluation standpoint, the study does not permit an analysis of the unique contribution made by DRO to the treatment effect. Only by carrying out analyses in which treatment packages are dismantled can one evaluate the unique effects of each component of the package (including the positive procedures). Unfortunately, dismantling studies, sometimes also referred to as component analyses (Barlow, Hayes, & Nelson, 1984), are rare in the literature. Therefore, one cannot determine from the literature on intervention packages the extent to which positive or aversive procedures contribute to the overall treatment effect.

The Issue of Hierarchy of Treatments

There is a widespread consensus in the field that less intrusive treatment procedures should be tried before more intrusive procedures. This notion of a hierarchy of treatments is sometimes referred to as the principle of the "least restrictive alternative" (Martin, 1975), meaning that if several treatment alternatives are available one should select first the treatment that best combines two features: a reasonable probability of success and the least risk to the individual. In practice, this principle has been translated to mean that positive procedures should be tried before aversive procedures. Thus, in virtually all studies involving aversives, one reads that positive procedures were tried first and only when they failed were aversives introduced. At this point it is important to note that there is a second consensus in the field; namely, that even if aversive procedures are effective, one should combine them with positive interventions designed to strengthen response alternatives to the behavior problems. Practically, this point of view has led to a literature on aversive treatment in which the majority of studies also include one or more of the positive interventions that we have been examining. To review all of these combined treatments would be tantamount to undertaking a review of most of the literature on aversive intervention. Since this literature has recently been analyzed in depth (Guess et al., 1987), there is no need to review it again.

Variables That Appear to be Peripheral

As noted earlier, Table 2 lists the specific empirical studies dealing with DRO, DRI, skills acquisition, and stimulus-based intervention that served as the basis for our evaluation. Some studies are marked with an asterisk (*) denoting that they were methodologically adequate. Specifically, 77 out of 96 studies evaluated (80%) met our earlier described criteria for methodological adequacy. Some studies are also marked with a pound sign (#), denoting that at least one subject in a particular study was a treatment success. We defined a treatment success as a 90% or better reduction in the level of behavior problems relative to baseline as measured during the final three sessions of the final treatment condition. As noted earlier, when it was not possible to determine from the data presented the mean of the last three sessions, we used the overall mean for the treatment condition of interest. Using this criterion, 53 out of 96 studies evaluated (55%) included at least one treatment success.

Although two of the treatment categories, skills aquisition and stimulus-based intervention, are further divided into subcategories, for purposes of evaluation we will combine the studies listed under the various subcategories. The number of subjects represented in many of the subcategories is quite small and therefore does not justify a separate analysis at this time.

Gender

Table 3 presents data on the relationship between gender and treatment outcome for various procedures. The key question is whether gender is an important consideration in choosing one treatment over another. In this table and the tables that follow, the data presented refer to the total number of cases across studies (e.g., for male DRO, 14 out

Table 3
Relationship of Gender to Treatment Outcome for Various Procedures

Gender	Procedure	Number of successes	% Successes
Male	DRO	14 out of 48	29
	DRI	6 out of 19	32
	Skills acquisition	16 out of 27	59
	Stimulus-based	19 out of 44	43
Female	DRO	5 out of 21	24
	DRI	3 out of 8	38
	Skills acquisition	8 out of 14	57
	Stimulus-based	7 out of 10	70

of 48 means that 14 cases out of a total of 48 cases across various studies were reported as treatment successes). Neither DRO nor DRI, from the studies evaluated, are very effective with either gender. Skills acquisition appears somewhat effective with both genders, and stimulus-based intervention appears especially effective with females. However, neither of these two procedures is dramatically more effective than the other with respect to either gender. In other words, treatment effectiveness does not appear to be strongly influenced by gender.

Diagnosis

Table 4 presents data on the relationship between diagnosis and treatment outcome for various procedures. Unfortunately, the most commonly cited diagnostic category in the literature is mental retardation with unspecified characteristics. This group is likely to be quite heterogeneous in nature and therefore treatment outcome is difficult to evaluate. The remaining diagnostic groups all involve small numbers of subjects and therefore any treatment differences may be due to sampling error. Keeping these limitations in mind, the key question is whether diagnostic category is an important consideration in choosing one treatment over another. Table 4 shows that DRO, skills acquisition, and stimulus-based intervention are about equal and produce the best outcome in treating persons diagnosed as mentally retarded with sensory impairment. Also, skills acquisition and stimulus-based intervention are about equal and produce the best outcome in treating persons diagnosed as mentally retarded with unspecified characteristics. Finally, DRI, skills acquisition, and stimulus-based intervention are about equal and produce the best outcome in treating persons diagnosed with autism. Interpretation is difficult in the other cases because of small sample size associated with several of the procedures. It is clear, however, that for each of the diagnostic categories mentioned, several different treatments appear to be effective. That is, no strong relationship emerges between a specific diagnostic category and a specific treatment procedure in terms of clinical outcome.

Table 4
Relationship of Diagnosis to Treatment Outcome for Various Procedures

Diagnosis	Procedure	Number of successes	% Successes
Mental retardation—identifiable chromosomal or genetic abnormality	DRO	1 out of 10	10
	DRI	1 out of 3	33
	Skills acquisition	1 out of 1	100
	Stimulus-based	—	—
Mental retardation—with sensory impairment	DRO	4 out of 10	40
	DRI	1 out of 5	20
	Skills acquisition	3 out of 7	43
	Stimulus-based	7 out of 16	44
Mental retardation—unspecified	DRO	13 out of 44	30
	DRI	5 out of 16	31
	Skills acquisition	12 out of 22	55
	Stimulus-based	12 out of 26	46
Autism	DRO	0 out of 3	0
	DRI	2 out of 3	67
	Skills acquisition	6 out of 9	67
	Stimulus-based	5 out of 9	56
Childhood schizophrenia/childhood psychosis	DRO	1 out of 2	50
	DRI	—	—
	Skills acquisition	1 out of 1	100
	Stimulus-based	2 out of 3	67
Not reported	DRO	—	—
	DRI	—	—
	Skills acquisition	1 out of 1	100
	Stimulus-based	—	—

If there is a relationship between diagnosis and treatment, it does not seem to be a compelling one. First, there are many instances in which individuals who have strikingly different diagnoses nonetheless receive the same treatment. Consider, for example, the use of DRO to control behavior problems. A study by Rose (1979), involving a girl diagnosed as schizophrenic, found an 88% reduction in problem behavior. A study by Singh and Pulman (1979), involving a boy with de Lange syndrome, found an 89% reduction in problem behavior. In other words, treatment outcome was about the same in spite of radically different diagnoses.

Second, there are many instances in which individuals who have the same diagnosis nonetheless receive different treatments. A study by Azrin, Besalel, Jamner, & Caputo (1988), involving a girl diagnosed as autistic, found a 92% reduction in problem behavior following the use of DRI. A study by Carr and Durand (1985a), involving a boy diagnosed as autistic, found a 100% reduction in problem behavior following the use of DRC. In other words, treatment outcome was about the same in spite of radically different treatments applied to individuals who had the same diagnosis.

It is true, of course, that traditional diagnostic categories included in DSM III-R are very important in addressing certain issues in developmental disabilities such as those pertaining to etiology and prognosis (Baroff, 1974; Rutter and Schopler, 1978). However, these same categories do not appear to be central in selecting an effective treatment directed at serious behavior problems in people with developmental disabilities. In fact, of the 96 studies presented in Table 2, none justified selection of a particular treatment in terms of an individual's diagnosis. There is an implicit consensus in the field that diagnosis, at least the traditional

variety, is not helpful in treatment planning.

Age

Table 5 presents data on the relationship between age and treatment outcome for various procedures. The table divides the population into 4 groups: preschool (0-5 years), elementary school (6-12 years), adolescence (13-19 years), and postadolescence (20 years and above). Again, small numbers of subjects in several of the groups hamper interpretation. The key question is whether age is an important consideration in choosing one treatment over another. If one excludes those data based on only a single case, then skills acquisition is best in treating the preschool and postadolescent groups and is tied with stimulus-based intervention in treating the adolescent group. Skills acquisition is second to DRI for the elementary school group. The fact that one intervention, skills acquisition, can be effective across the entire age range, suggests that treatment outcome is not strongly influenced by age.

Degree of Retardation

Table 6 presents data on the relationship between the degree of retardation (mild, moderate, severe, and profound) and treatment outcome for various procedures. The key question is whether degree of retardation is an important consideration in choosing one treatment over another. If one excludes those data based on only one case, then a pattern emerges in which either skills acquisition or stimulus-based intervention generally produce the best outcome irrespective of the degree of retardation. Again, small sample size makes conservative interpretation imperative. Overall, a strong case cannot be made for the idea that treatment effectiveness is critically determined by level of retardation.

Table 5
Relationship of Age to Treatment Outcome for Various Procedures

Age (Years)	Procedure	Number of successes	% Successes
0-5	DRO	1 out of 6	17
	DRI	1 out of 1	100
	Skills acquisition	5 out of 9	56
	Stimulus-based	1 out of 3	33
6-12	DRO	8 out of 31	26
	DRI	4 out of 5	80
	Skills acquisition	10 out of 17	59
	Stimulus-based	6 out of 12	50
13-19	DRO	7 out of 18	39
	DRI	2 out of 7	29
	Skills acquisition	4 out of 6	67
	Stimulus-based	10 out of 15	67
20 +	DRO	3 out of 14	21
	DRI	2 out of 14	14
	Skills acquisition	5 out of 9	56
	Stimulus-based	6 out of 19	32
Not reported	DRO	—	—
	DRI	—	—
	Skills acquisition	—	—
	Stimulus-based	3 out of 5	60

Table 6
Relationship of Degree of Retardation to Treatment Outcome for Various Procedures

Degree of retardation	Procedure	Number of successes	% Successes
Mild	DRO	4 out of 13	31
	DRI	—	—
	Skills acquisition	3 out of 4	75
	Stimulus-based	2 out of 2	100
Moderate	DRO	3 out of 12	25
	DRI	1 out of 1	100
	Skills acquisition	5 out of 7	71
	Stimulus-based	0 out of 2	0
Severe	DRO	2 out of 11	18
	DRI	3 out of 5	60
	Skills acquisition	2 out of 5	40
	Stimulus-based	7 out of 14	50
Profound	DRO	8 out of 26	31
	DRI	4 out of 20	20
	Skills acquisition	2 out of 5	40
	Stimulus-based	11 out of 21	52
Not reported	DRO	2 out of 7	29
	DRI	1 out of 1	100
	Skills acquisition	12 out of 20	60
	Stimulus-based	6 out of 15	40

Treatment Setting

Table 7 presents data on the relationship between treatment setting and treatment outcome for various procedures. The key question is whether treatment setting is an important variable in choosing one treatment over another. If one removes from consideration those treatment settings in which data are available for only a small number of cases, it appears that skills acquisition and stimulus-based intervention are more effective in both schools and institutions than DRO or DRI. In other words, treatment effectiveness does not appear to be strongly influenced by treatment setting. There is one caveat worth noting here. Specifically, only a few studies were reported that dealt with treatment in the community (home/work) as opposed to the many studies reported on treatment in segregated schools and institutions. Thus, it would be inappropriate at this stage of inquiry to conclude that community settings do not make a difference. Many more systematic and

Table 7
Relationship of Treatment Setting to Treatment Outcome for Various Procedures

Treatment setting	Procedure	Number of successes	% Successes
Classroom	DRO	6 out of 26	31
	DRI	1 out of 5	20
	Skills acquisition	14 out of 23	61
	Stimulus-based	8 out of 16	50
Institution	DRO	11 out of 33	33
	DRI	6 out of 18	33
	Skills acquisition	9 out of 16	56
	Stimulus-based	17 out of 35	49
Home/Work	DRO	0 out of 4	0
	DRI	2 out of 3	67
	Skills acquisition	1 out of 2	50
	Stimulus-based	1 out of 1	100
Special medical unit	DRO	0 out of 6	0
	DRI	0 out of 1	0
	Skills acquisition	—	—
	Stimulus-based	0 out of 1	0
Not reported	DRO	—	—
	DRI	—	—
	Skills acquisition	—	—
	Stimulus-based	0 out of 1	0

methodologically sound studies need to be carried out on the impact of treatment in the community to do full justice to this approach.

Target Behavior

Table 8 presents data on the relationship between target behavior and treatment outcome for various procedures. The entry labeled aggression and self-injury refers to those studies in which both of these behaviors were observed in the same individual and does not refer to a pooling of studies on aggression with studies on self-injury. The key question is whether target behavior is an important consideration in choosing one treatment over another. Again, if one excludes comparisons involving only 1 or 2 cases, then skills acquisition and/or stimulus-based intervention typically generate the highest rates of success across all target behaviors. (DRO may be most effective for rumination but the sample size is small.) In other words, treatment effectiveness is not strongly influenced by the nature of the target behavior.

Table 8
Relationship of Target Behavior to Treatment Outcome for Various Procedures

Target behavior	Procedure	Number of successes	% Successes
Self-injury	DRO	10 out of 35	29
	DRI	7 out of 23	30
	Skills acquisition	3 out of 6	50
	Stimulus-based	13 out of 25	52
Aggression/ Tantrums	DRO	6 out of 30	20
	DRI	2 out of 2	100
	Skills acquisition	11 out of 22	50
	Stimulus-based	5 out of 12	42
Aggression and self-injury	DRO	—	—
	DRI	0 out of 1	0
	Skills acquisition	9 out of 12	75
	Stimulus-based	1 out of 6	17
Rumination/ Vomiting	DRO	3 out of 4	75
	DRI	0 out of 1	0
	Skills acquisition	1 out of 1	100
	Stimulus-based	7 out of 11	64

Conclusion

Again, interpretation of the data on the six factors just described is made difficult by the small number of subjects available for comparison purposes. At this point we may conclude that, overall, there are no compelling data demonstrating that gender, diagnosis, age, degree of retardation, treatment setting, or target behavior are critical variables to consider in selecting treatments. At the moment the field is in flux and is struggling to identify variables that may be central to treatment planning. The most frequently cited candidates are the motivational and antecedent factors to be discussed next. Sporadically in the past, and increasingly so in the present, these variables have been a focus of functional analysis and treatment planning.

Variables That Appear to be Central

In recent years there has been a trend toward the use of functional analysis as a means for the rational and systematic selection of treatment interventions. It will be recalled that functional analysis is a method of assessment wherein the variables of which behavior problems are a function are identified through experimental manipulation. In many respects this strategy reflects a growing feeling among clinical researchers that there has been too much behavior modification in the field and not enough behavior analysis. Or, to put it in other terms, there has been an overemphasis on the purely technical aspects of treatment and an underemphasis on basing treatment selection on the functional properties of behavior. Even when a formal functional analysis is not carried out, it is still possible to hypothesize which variables likely control a given behavior problem and then to base treatment selection on a given hypothesis (Repp, Felce, & Barton, 1988). Hypothesis-driven treatment is closely related at a conceptual level to functional analysis.

Given the increasing centrality of functional analysis to the practice of positive intervention, it is worthwhile to examine the general classes of variables that have been demonstrated or suggested to be important in the control of behavior problems. We must note at the outset that the systematic analysis of consequences has far outstripped the parallel analysis of antecedent factors. For this reason, we will focus primarily on consequences (motivational variables). However, it is important to emphasize that the power of antecedent factors to control behavior typically derives from their close association with specific motivational factors. Therefore, when we evaluate (in a later section) various positive interventions with respect to their relationship with different controlling antecedents and consequences, we will frequently highlight the interplay between these two sets of variables.

Motivational Factors

These factors can be subdivided into positive reinforcers (stimuli whose presentation, contingent on the performance of a behavior, increases the frequency of the behavior) and negative reinforcers (stimuli whose cessation, contingent on the performance of a behavior, increases the frequency of the behavior). Each type of reinforcer can be further subdivided along an extrinsic versus intrinsic dimension with extrinsic reinforcers referring to external stimuli (those existing outside the body) and intrinsic reinforcers referring to internal stimuli (those existing inside the body).

Positive reinforcers: Extrinsic (social and tangible). There are many instances in which behavior problems appear to be maintained by social and tangible reinforcers (Bachman, 1972; Carr, 1977; Carr & Durand, 1985b; Demchak & Halle, 1985; Frankel & Simmons, 1976; Schroeder, Rojahn, Mulick, & Schroeder, in press). Consider first the case of social reinforcement. An individual may engage in self-injury or aggression when there is a decrease in the level of attention that he or she is receiving from others (Carr & Durand, 1985a; Lovaas et al., 1965). The performance of a self-injurious behavior may then act to reinstate or increase the amount of attention received from others. If a functional analysis suggests that a behavior problem is maintained by social reinforcement, then a rational approach to treatment might involve teaching the individual new (nonproblematic) behaviors to gain attention as well as ensuring that the old (problematic) behaviors no longer succeed in generating attention (Carr, 1988).

Consider the case of tangible reinforcement. An individual may engage in serious behavior problems because such behavior reliably results in other people providing the individual with specific tangible reinforcers such as access to a toy, snacks, or playground equipment (Durand & Crimmins, 1988; Edelson, Taubman, & Lovaas, 1983). Rational treatment might therefore involve teaching the individual new ways of requesting tangible items. These ways could involve the use of speech, sign language, or picture boards.

Positive reinforcers: Extrinsic and intrinsic (sensory). Some instances of severe behavior problems, especially self-injury, appear to be maintained by sensory reinforcers. That is, given a relatively impoverished physical environment, individuals may engage in self-injurious acts that generate a variety of extrinsic sensory stimuli including those that are visual, auditory, or tactile in nature as well as intrinsic stimuli including those that are gustatory, vestibular, or kinesthetic. The behavior problem is maintained by the sensory stimulation it generates (Carr, 1977; Favell, McGimsey, & Schell, 1982; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982; Rincover & Devaney, 1982). In this case, treatment intervention based on a knowledge of controlling variables might well consist of arranging for the removal of the sensory consequences generated by the self-injurious behavior thereby extinguishing the behavior. Since this goal may be difficult to achieve, particularly for self-injury maintained by intrinsic stimuli, another strategy, and one more in keeping with the positive approach to intervention, might be to provide the individual with alternative sources of equivalent sensory stimulation. Thus, if an individual engages in self-injurious eye-poking for the presumptive purpose of generating phosphenes, then one could provide toys that also generate a rich array of visual stimuli, for example, kaleidoscopes or video games. These new sources of stimulation may make self-injury unnecessary and the behaviors associated with toy play can eventually replace the problem behavior.

Positive reinforcers: Intrinsic (organic). There is a large literature demonstrating that behavior problems, particularly self-injury, are often associated with organic conditions (Baumeister & Rollings, 1976; Carr, 1977; Romanczyk, Gordon, Crimmins, Wenzel, & Kistner, 1980; Schroeder et al., in press). It has been suggested that some of the correlated biological variables actually may be motivational in nature. Specifically, one hypothesis is that in some instances, self-injurious behavior may result in the release of endogenous opiates into the bloodstream (Cataldo & Harris, 1982). If so, then the behavior could be seen as self-addicting, since the release of these opiates constitutes a powerful (intrinsic) reinforcer. If a functional analysis (in the biochemical realm) indicated that the opioid hypothesis was relevant to a particular case of self-injury, then rational treatment planning might include pharmacological intervention designed to block the effects of the endogenous opiates. In fact, data suggest that naltrexone, an opiate an-

tagonist, may reduce self-injury in some cases (Herman et al., 1987). We mention this point only in passing in order to demonstrate that hypothesis-driven intervention need not characterize positive approaches alone, but may well be an important trend in the psychopharmacology area as well, a trend that stands in marked contrast to current psychopharmacological approaches that are not, for the most part, hypothesis-driven.

Negative reinforcers: Extrinsic and intrinsic (escape). A wide variety of self-injurious, aggressive, and tantrum behavior appears to be maintained by the cessation of aversive stimuli, that is, negative reinforcement (Carr, 1977; Carr & Durand, 1985b; Iwata, 1987; Sailor, Guess, Rutherford, & Baer, 1968; Schroeder et al., in press). For example, an individual may respond to difficult instructional demands by becoming aggressive (Carr et al., 1980), self-injurious (Carr et al., 1976), or tantrumous (Carr & Newson, 1985). Such behavior often results in the teacher withdrawing the demands; that is, the individual escapes from the instructional situation. Since the demands are presumably aversive, the problem behavior is thereby negatively reinforced and more likely to occur the next time that frustrating demands are presented. When, through functional analysis, a behavior is known to be controlled by negative reinforcement processes, common treatments such as timeout must be avoided. Since timeout would involve removing the individual from the demand situation, this treatment would in fact exacerbate the problem, a fact that has been documented empirically (Carr et al., 1980; Plummer, Baer, & LeBlanc, 1977). Thus, functional analysis may suggest also what treatments not to use. Once escape motivation has been established as a relevant variable, several treatments may be rationally deduced. In the instructional situation described earlier, one may institute interventions that reduce task aversiveness or allow the individual to solicit help.

The aversive stimuli just described were extrinsic in nature. Some data suggest, however, that at times they may be intrinsic in nature. For example, DeLissovoy (1963) noted an association between head-banging and painful middle ear infection (otitis media) in young children. He hypothesized that head-banging may have been a form of pain relief in which case the behavior was maintained by intrinsic negative reinforcement. That is, the children banged their heads in order to produce a cessation or attenuation in the level of the aversive (pain) stimulus. If a functional analysis (of biological variables) suggests that intrinsic negative reinforcement is a relevant factor, then rational treatment planning would call for specific pharmacological intervention.

Antecedent Factors

There has been growing interest in the functional analysis of antecedent factors in order to determine what role they may play in understanding and eventually ameliorating behavior problems. A variety of simple and complex stimuli have been identified that exert control over severe behavior problems. The list of such stimuli includes demands (e.g., Carr et al., 1980), crowding (e.g., Boe, 1977; McAfee, 1987), staff change (Touchette et al., 1985), vestibular stimulation (e.g., Dura, Mulick, & Hammer, 1988), exercise (e.g., Baumeister & MacLean, 1984), certain items of clothing (e.g., Rojahn, Mulick, McCoy, & Schroeder, 1978), and task repetition (e.g., Winterling et al., 1987). This list is a small sample from a literature that is increasing rapidly each year. The literature presents a great opportunity and a great danger at the same time.

The danger is that clinicians will develop an ever-growing list of potential stimulus variables without also developing decision rules that will help them select in a rational manner those stimuli that have the greatest treatment potential in a given case. This scenario could result in a laundry list of stimulus-based clinical tricks that is inefficient at best and ineffective at worst. The opportunity is that researchers can begin to develop a conceptual system in the area of stimulus control that will parallel the conceptual system already developed in the area of motivational control and documented in the section of the monograph just presented. A good starting point for conceptual development in this area would be to link motivational constructs to stimulus control constructs. As noted earlier, stimulus control is frequently related to motivational variables. That is, in operant theoretical terms, stimuli are frequently discriminative for various contingencies and types of reinforcers. The relationship between stimulus and reinforcer can determine the presence or absence of a response, the temporal distribution of responding, response intensity, and response-response relationships. Two examples can be given to illustrate potential avenues of conceptual development. First, topographically dissimilar stimuli such as demands, crowding, and task repetition may be grouped under a single functional category, aversive stimulation. That is, these stimuli signal (are discriminative for) severe behavior problems, because such problems have in the past been effective in extricating the individual from unpleasant circumstances by bringing about the cessation of demands, less crowding, or greater task variety. In other words, a wide variety of stimuli may be functionally linked through the process of extrinsic negative reinforcement. A second example involves vestibular stimulation and exercise. These two sets of stimuli may, depending on the intervention used,

appear quite dissimilar. Yet, they may be linked functionally through a process of intrinsic positive reinforcement. Consider that environments providing little sensory stimulation may be discriminative for those behavior problems that reliably generate high levels of the relevant sensory stimuli. Therefore, if one provides an individual with the relevant sensory stimuli (by making available vestibular stimulation or exercise), then the motivation for exhibiting behavior problems is undermined. Alternatively, it may be that provision of vestibular stimulation and exercise helps modulate arousal levels as per some neurophysiological theories of autistic behavior (Hutt & Hutt, 1970). If behavior problems serve a similar arousal-modulating function (Guess et al., 1988), then implementation of the type of intervention described may reduce the need for the individual to engage in problem behavior.

Our discussion suggests that understanding the functional link between various antecedent factors and their motivational counterparts can aid in the process of categorizing an array of otherwise topographically distinct stimuli and in so doing facilitate the process of rationally deducing treatments. It is worth adding, however, that the successful categorization of stimuli into functional classes is likely to depend on a consideration of other variables besides the motivational factors on which we have focused. The research and conceptual challenge of the future pertains to the identification of what these additional factors are, be they respondent, organic, or some as yet undefined variable.

Impact on Treatment Planning

The focus on motivational and antecedent factors represents one of the most significant trends in the field today. Functional analysis and hypothesis-driven treatment constitute a method for deducing plausible intervention strategies in a systematic and rational manner. As noted, some of these strategies fall in the category of positive (environmental) treatment, whereas others likely fall in the category of biological treatment. In our later examination of the treatment effects of DRO, DRI, skills acquisition, and stimulus-based intervention, we will attempt to relate each of these procedures to the broader context of motivational and antecedent factors. It is this context that may provide a unifying theme for the field.

Generalization

Stimulus Generalization

Stimulus generalization refers to the degree to which treatment effects transfer from the original treatment situation to other situations involving new treatment agents, physical settings, and tasks. It is important to note that stimulus generalization does not refer to treatment effects that occur in new situations following the introduction of treatment into those situations. Stimulus generalization involves a behavior change that occurs in spite of the fact that no treatment is occurring in the new situation. Using this stringent and technically correct criterion, only a few of the studies reviewed later report systematic data on stimulus generalization.

Response Generalization

Response generalization refers to the degree to which treatment effects transfer from the initial target problem to other aspects of the individual's behavior repertoire. Consider a child who engages in self-injury and aggression but rarely talks to adults. If the child's self-injury is treated and not only does the self-injury decrease but the child also shows less aggression and more conversation with adults, then the treatment procedure would be described as producing response generalization. It is critical to note that the change in aggression and conversation with adults occurs in spite of the fact that these two classes of behavior are not directly treated. If they were treated, then response generalization would not be said to have occurred. Instead, we would say that multiple behavior change had occurred simply because multiple behaviors were targeted for treatment. The mechanisms underlying response generalization are poorly understood at present (Carr, 1988).

Maintenance

Maintenance (or temporal generalization) refers to the degree to which treatment effects last over time (treatment durability). This dimension of behavior change has been interpreted differently by different investigators. Some investigators have held that maintenance can be said to have occurred only when the specific treatment of interest has been completely terminated and behavior problems remain at a level significantly below baseline. This interpretation constitutes a strong criterion for judging maintenance. Other investigators have held that maintenance can be said to have occurred when the level of treatment is less than that initially employed. For example, fewer treatment sessions per day may be conducted or some elements of a treatment package may be faded. This interpretation constitutes a weak criterion for judging maintenance. Our analysis of maintenance effects includes studies involving both types of criteria. To anticipate a point made in greater detail later, there is always a question in studies of maintenance whether treatment durability can be unambiguously ascribed to the treatment initially used or whether the posttreatment en-

vironment contains elements that are crucial to facilitating or inhibiting durability of treatment effects. Since the post-treatment environments are rarely described in a systematic and empirical fashion, the factors promoting maintenance of any treatment are at the moment poorly understood.

V. INTERVENTIONS

DRO

Treatment Effects

Table 9 summarizes the effectiveness of the four types of intervention in terms of the percentage reduction from baseline of the target behavior. A single study could include several different subjects whose treatment outcomes varied widely; hence, the sum of the number of studies listed here exceeds the number listed in Table 2.

The most striking finding is that the effectiveness of DRO runs the entire gamut from 100% reduction of the behavior problem (7 subjects in 7 studies) to 0 to 19% reduction (5 subjects in 5 studies). Surprisingly, in the case of 8 subjects in 7 studies, DRO produced an increase in the level of the behavior problem over baseline.

Relation to Central Variables

How may DRO be related to the motivational and antecedent factors derived from functional analysis as discussed earlier? To begin, we must note that the decision to use DRO is not based on a prior functional analysis. Yet, with a 90% reduction criterion, 15 subjects were successfully treated. The traditional explanation for treatment success is that DRO strengthens many nonproblematic behaviors and these eventually replace the problem behavior. None of the successful cases provided documentation to demonstrate the systematic emergence of nonproblem behavior. Given the absence of these data, it may be heuristic to suggest alternative explanations (without necessarily rejecting the traditional explanation) based on a consideration of central variables.

DRO can be reconceptualized in terms of antecedent factors. Specifically, consider the case in which tangible reinforcers are used. The repetitive delivery of food could be viewed as an antecedent factor; that is, it constitutes a stimulus that controls low rates of behavior problems, in essence, a stimulus-based treatment. As long as the DRO interval is short, the individual will be almost continuously engaged in food-related responding. Many clinicians, in desperation, will often try to "distract" an individual from performing his or her problem behavior by introducing new stimuli at a high rate. Perhaps DRO is a systematic form of distraction. The point is that the stimulus aspects of the DRO procedure have not been explored systematically in the literature. The above analysis suggests that such exploration may be fruitful in selected cases.

DRO can also be reconceptualized in terms of any of three motivational factors: social, tangible, and sensory. Consider the social and tangible variables. In those cases in which a behavior problem is motivated by attention-seeking or tangible-seeking, it is conceivable that the use of DRO makes the behavior problem unnecessary. Thus, if a child has been head-banging ostensibly to get attention and a DRO is instituted involving effusive praise and conversation, then the self-injury should become nonfunctional and decrease in frequency, at least during the time the procedure is applied. Likewise, if a child is aggressive due to hunger (tangible-seeking) and a DRO is instituted involving foods, then the aggressive behavior should become nonfunctional and decrease. Consider the sensory variable. As noted before, some instances of self-injury appear to be motivated by the sensory stimulation they generate. If so, then providing a DRO in which tactile, visual, auditory,

Table 9
Summary of Effectiveness of Positive Approaches

Procedure	Percentage suppression of target behavior							
	100	90-99	80-89	60-79	40-59	20-39	0-19	Increase
DRO								
Studies	7	11	8	7	10	5	5	7
Subjects	7	12	10	10	11	6	5	8
DRI								
Studies	4	3	1	3	2	4	2	4
Subjects	5	4	1	4	2	5	2	4
Skills acquisition								
Studies	8	11	3	5	4	—	1	1
Subjects	10	14	3	7	5	—	1	1
Stimulus-based								
Studies	7	13	8	9	2	2	1	1
Subjects	9	17	9	13	2	2	1	1

or other relevant stimuli are provided again may make the behavior problem unnecessary.

Our discussion suggests that the effectiveness of DRO might well be enhanced by conducting a careful functional analysis prior to treatment implementation. Such an analysis could better identify reinforcing stimuli that would exert powerful antecedent control over nonproblematic behavior. In addition, the identification of the reinforcing variables maintaining behavior problems would allow judicious selection of equivalent reinforcers to be used as part of the DRO contingency. In contrast, the absence of functional analysis could lead to the use of stimuli and reinforcers that are largely irrelevant to the behavior being treated, thereby increasing the likelihood of treatment failure. This outcome might be especially likely to occur in instances in which behavior problems are controlled by organic or escape variables.

Advantages and Disadvantages

There are two clear advantages to using DRO. First, the procedure is easy to implement; thus, long periods of staff training are not required. Second, to the extent that the reinforcing stimuli involved in the DRO contingency are powerfully discriminative for nonproblem behavior, DRO (as discussed previously) may function more like a stimulus-based treatment than a reinforcement-based treatment. In this case, the rapid treatment effects characteristic of other stimulus-based procedures may also be seen here.

The most obvious disadvantage of DRO concerns the possibility of satiation. If the DRO interval is short and the reinforcer used is food, then it is likely that after a period of time, the individual under treatment will have consumed so much food that food will lose its reinforcing properties. Theoretically, at this point, DRO would become ineffective and there should be a deterioration in behavior.

A second disadvantage concerns the possibility that DRO could inadvertently strengthen undesirable behavior. Suppose the behavior under treatment is self-injury. Since the DRO contingency does not specify what "other" behavior need occur at the end of an interval free of self-injury, it is possible that reinforcement will be given at a time when the individual is engaging in some other objectionable behavior (e.g., spitting, screaming). If this possibility exists, the DRO contingency would need to be changed to include these other objectionable behaviors as well or a different treatment would need to be considered.

Third, if an individual is engaging almost continuously in behavior problems, there may be no opportunity for reinforcement. This situation is sometimes seen in individuals exhibiting very high rates of self-injury. In this case, there may be few or no intervals free of the behavior problem. Attempts to use DRO in this situation may result in reinforcers being given too close in time to the behavior problem, thereby possibly exacerbating the problem.

Fourth, DRO may interfere with educational efforts. For example, if behavior problems are frequent in the classroom, then the repeated application of DRO could reduce the amount of time available for instruction, particularly, as is often the case, if educational efforts are halted while the procedure is being applied.

Fifth, DRO is a personnel-intensive procedure. Typically, a person must be constantly present to monitor the behavior of the individual, to time the interval, and to dispense reinforcement. The presence of several individuals requiring DRO treatment at the same time may unduly tax personnel resources. However, some data now suggest that once the effects of DRO are well established, it may be possible to reduce the level of monitoring so that behavior is checked only at the end of the DRO interval rather than during the entire interval (Repp, Barton, & Brulle, 1983). Thus, the procedure can become less personnel intensive and therefore more practical.

Finally, as noted earlier, DRO may be a nonfunctional or counterproductive procedure. For example, if an individual's behavior problems are escape motivated (e.g., escape from educational tasks), then halting instructional periods while DRO is in effect may be tantamount to negatively reinforcing undesirable behavior. This problem could be avoided by conducting a functional analysis of the problem prior to making a treatment decision. Unfortunately, however, as the published literature makes clear, selection of DRO as an intervention is not based on functional analysis.

DRI

Treatment Effects

The data for DRI parallel those for DRO. Specifically, effectiveness of treatment ranges from 100% reduction (5 subjects in 4 studies) to 0 to 19% reduction (2 subjects in 2 studies). As with DRO, in a small number of cases, the procedure made the behavior problem worse (4 subjects in 4 studies).

Relation to Central Variables

The use of DRI, like DRO, is not based on a prior functional analysis of controlling variables. Not surprisingly, therefore, many of the points made with respect to DRO can also be made for DRI. It is possible, for example, that the successful use of DRI may be related to whether or not the reinforcer chosen to strengthen the physically incompatible response is functionally related to the reinforcers maintaining the problem behavior. That is, success may

depend more on functional equivalence of reinforcers than on physical incompatibility of responses. This possibility has yet to be examined empirically. It is conceivable, therefore, that the low rate of treatment success reflects the general lack of relationship between DRI and the central variables that we have discussed.

Advantages and Disadvantages

The major advantage of DRI is that the selection of a response that is physically incompatible with the problem behavior virtually ensures the elimination of the problem behavior as long as the incompatible response is maintained.

The major disadvantage of DRI is that the incompatible response may interfere with other activities. Consider an individual who engages in self-injurious face-slapping. If the incompatible response consists of keeping one's hands in one's pockets, then activities such as play or even eating become impossible. Clearly, DRI can rarely be applied alone and other treatments are needed to supplement and eventually replace DRI.

A second disadvantage concerns the case in which the incompatible response is not already in the individual's repertoire and therefore must be taught through prompting and other instructional procedures. Because instruction takes time, DRI would not be a good crisis management strategy. Some other procedure would need to be implemented to control problem behavior quickly. The other disadvantages of DRI are similar to those noted earlier for DRO. Specifically, DRI is personnel-intensive and rarely based on prior functional analysis, thereby raising the possibility that in some instances it may be ineffective or perhaps counterproductive.

Skills Acquisition

Treatment Effects

The data for this procedure show relatively higher levels of behavior problem reduction than the other procedures just discussed. A 100% reduction was achieved for 10 subjects in 8 studies. Only 2 subjects obtained less than a 40% reduction in behavior problems. The behavior of one of these subjects was made worse by the treatment.

Relation to Central Variables

Some forms of skills acquisition are based directly on prior functional analysis. DRC is the clearest example. As noted previously, the specific communicative forms that are trained typically are related to the social, tangible, and escape variables identified through functional analysis. Of course, there is no a priori reason to expect that problems maintained by organic or sensory factors would also respond to DRC. That is, teaching a child to request attention, for example, should have no effect on controlling head-banging maintained by vestibular stimulation or endogenous opiates. This notion has yet to be tested, however.

Consider, next, compliance training. It is conceivable that this procedure could be especially useful in the case of attention-seeking individuals. For them, compliance may represent a new and reliable means of generating social interaction with significant others. Alternatively, for some individuals, the commands involved in the compliance procedure may already be powerful discriminative stimuli that evoke responses that are incompatible with behavior problems. Thus, antecedent factors may also be involved.

The relation of self-management to central variables is unclear at present. Possibly, the various self-statements acquired by the individual function as discriminative stimuli that evoke responses that actively compete with the behavior problem. This notion of the role of antecedent factors is speculative of course and has not been systematically tested.

Finally, consider the case of functional independence training. During the course of acquiring broad behavior repertoires involving vocational skills, self-help, and leisure skills, an individual learns to respond appropriately to a wide variety of new stimuli. Thus, as a consequence of training, many stimuli are created that are discriminative for nonproblem behavior. In this manner, functional independence training may reduce the frequency of behavior problems via antecedent factors. In addition, this training could address certain motivational factors. For example, vocational skills may constitute a new means for gaining the attention of others and leisure skills may be a new means for accessing preferred sensory stimuli. If so, then behavior problems maintained by attention and sensory variables may become unnecessary.

Advantages and Disadvantages

The major advantage of all interventions based on the development of skills is that the individual acquires a variety of new behaviors that are potentially useful in the daily living environment. The acquisition of compliance, self-management, communication, and greater independence (e.g., leisure skills, self-help skills) represent genuine educational gains for the individual and may have greater long-term significance than the mere elimination of undesirable behavior.

A second advantage is that some instances of skill-based intervention directly address the function of the behavior problem. Specifically, a procedure such as DRC is designed to give the individual a socially desirable way to achieve, in lay terms, the same goals as the behavior problem under treatment, thereby making such behavior unnecessary.

Third, the skills taught in the interventions we have been discussing typically produce desirable outcomes (reinforcers) for the individual. For example, compliance is likely to be supported by significant others whenever the behavior occurs. In principle, then, there is no reason for such skills to decrease over time. Treatment maintenance may be a built-in feature of skills acquisition.

The major disadvantage of skill-based intervention is that it frequently requires considerable expertise on the part of the treatment agent. To the extent that a functional analysis is an integral part of intervention planning, many typical treatment agents (e.g., parents, classroom aides) will require the support and consultation of professionals who have been trained to carry out the relevant analyses. In addition, treatment implementation can involve carrying out complex clinical protocols and this fact can also create difficulties for relatively unsophisticated personnel.

A second disadvantage, noted previously, is that interventions based on skills acquisition ordinarily require a period of training during which the skill is gradually strengthened. Because of the time factor involved, skill-based intervention would not by itself be the treatment of choice in a crisis situation in which quick effects are imperative.

Finally, some of the interventions, notably self-management, likely require that the person undergoing treatment has a minimal level of language competence, since the procedural effects are linguistically mediated. For this reason, some variants of skill-based intervention may be inappropriate for individuals who have severe language deficits. The nature of these limitations has not yet been systematically researched.

Stimulus-Based Treatments

Treatment Effects

The data for this intervention parallel those for skills acquisition in that treatment effects cluster at the higher levels of behavior problem reduction. Specifically, a 100% reduction was achieved for 9 subjects in 7 studies. Only 4 subjects obtained less than a 40% reduction in behavior problems. One of these subjects was made worse by the treatment.

Relation to Central Variables

Several instances of stimulus-based treatment may be related to negative reinforcement processes. First, modifying stimuli that control high rates of behavior problems might involve simplifying frustrating (aversive) educational tasks to produce higher levels of academic success. Second, modifying educational curricula might involve reducing task repetitiveness (boredom) by introducing a variety of tasks in a given period of time. Third, ameliorative use of setting events might involve reducing aversive crowded conditions by providing additional living space. Finally, embedding stimuli that control high rates of behavior problems among those that control low rates might involve placing aversive demands in the context of positive conversational exchange in a process analogous to counterconditioning. All four examples described involve procedures designed to reduce the aversiveness of a stimulus, thereby making escape behavior (i.e., behavior problems maintained by negative reinforcement) unnecessary.

Some instances of stimulus-based treatment may be related to sensory reinforcement processes. For example, the ameliorative use of setting events could involve the introduction of periods of exercise or noncontingent tactile, vestibular, and gustatory stimulation. This type of intervention might be especially potent in dealing with behavior problems whose motivation is sensory, since the individual can now access relevant sensory stimuli without having to resort to particular forms of self-injury or aggression.

It is likely that stimulus-based treatment may also be related to processes involving social and tangible reinforcement. The discussion presented makes clear, however, that functional analysis could be useful in systematically selecting the type and form of stimulus-based treatment although, to date, it has been greatly underutilized in this area.

Advantages and Disadvantages

The major advantage of stimulus-based intervention lies in its potential for producing rapid behavior change. The introduction of new discriminative stimuli into a situation is typically accompanied by a sudden increase in the behaviors controlled by such stimuli and a decrease in other behaviors. Thus, careful programming of appropriately selected stimuli could produce a rapid decrease in the level of behavior problems, an effect normally associated with aversive stimuli. The further elaboration of stimulus-based procedures through research could result in technological alternatives to the use of aversive intervention.

A second advantage is that some instances of stimulus-based intervention directly address the function of the behavior problem. For example, if a difficult educational task is identified as an aversive stimulus that evokes escape-motivated self-injury, then temporarily changing (simplifying) the task could produce a rapid shift to a low level of self-injury. In this case, the use of task simplification was dictated by the functional nature of the behavior problem. Removing the motivation for self-injury in this manner makes further performance of the problem behavior unnecessary.

The primary disadvantage of stimulus-based interven-

tion is that the maintenance of treatment gains may be overly dependent on a particular stimulus configuration. Consider a situation in which an individual engages in self-injury during vocational activities but not during play time. Theoretically, if one were to extend play time throughout the day, one could produce long periods during which the individual was free of self-injury. But these gains are fragile, since reintroduction of vocational activities may evoke new bouts of self-injury. In addition, the individual is not being taught potentially important work skills during the protracted play period. The example demonstrates that stimulus-based intervention may be temporarily beneficial because it produces decreases in behavior problems. However, these decreases will not be clinically significant unless other interventions are designed and implemented to allow the individual to function well in the presence of more normalized stimulus configurations.

Comparative Effectiveness

Table 10 summarizes the comparative effectiveness of the four categories of positive treatment approaches using a 90% or more suppression criterion. All procedures had some degree of success. It is clear, however, that skills acquisition (59% success) and stimulus-based interventions (48% success) were superior overall to DRO (28% success) and DRI (33% success). This outcome is especially significant in view of the fact that skills acquisition and stimulus-based interventions are more closely tied to the use of functional analysis than either DRO or DRI. Perhaps a more systematic and sophisticated use of functional analysis as an aid to treatment planning would further improve outcome.

Generalization

Stimulus Generalization

As noted earlier, stimulus generalization can occur with respect to new treatment agents, physical settings, and tasks. Only a few of the studies reviewed reported systematic data on stimulus generalization. More typically, studies reported anecdotal observations. For example, consider the literature on DRO. Luiselli et al. (1985) noted that the reduction in aggression and self-injury observed for two individuals following DRO treatment generalized to new teachers (treatment agents). Weiher and Harman (1975) noted that decreases in head-banging for one child generalized to a new situation (physical setting) in which the protective helmet which the child wore was removed. These anecdotal reports, although encouraging, are difficult to interpret because of the lack of reliability assessment and the lack of quantification concerning magnitude of effect.

Table 10
Comparative Effectiveness of Positive Approaches Using a 90% of More Suppression Criterion

Procedure	Number of successes	% Successes
DRO	19 out of 69	28
DRI	9 out of 27	33
Skills acquisition	24 out of 41	59
Stimulus-based	26 out of 54	48

There are a handful of reports in the literature involving systematic (data-based) evaluation of stimulus generalization. In the DRO literature, Neufeld and Fantuzzo (1987) documented that, for one individual who had engaged in self-injurious face-slapping, there was a 78% reduction from the baseline in the problem behavior when it was measured in a new setting.

In the DRI literature, Mace et al. (1983) observed a 100% reduction in the tantrums and aggressive behavior (hitting, scratching, head-butting) of one individual when the behavior was measured in the presence of new therapists and in new settings.

In the skills acquisition literature, Billingsley and Neel (1985) treated the aggressive grabbing behavior of one person using a communication-based approach. Following treatment, they observed a 49% and 71% reduction respectively in the problem behavior as measured in two new settings. Day, Rea, Shussler, Larsen, and Johnson (1988) treated the self-injurious behavior of two individuals using a communication approach and then measured generalization to new settings. For one individual, a 39% and 45% reduction, respectively, was seen in two new settings. For the other they noted an 8%, 67%, and 90% reduction, respectively, in three new settings. Skills acquisition involving communication training may produce generalization effects not only across settings (as just noted) but across treatment agents as well. Durand (1984), in a doctoral dissertation, noted that 12 out of 12 children with developmental disabilities who had been treated with DRC displayed reductions of 90% or more in behavior problems in the presence of new teachers who were not associated with the original treatment.

Finally, with respect to stimulus-based intervention, it is often difficult to evaluate generalization because of certain methodological and conceptual issues. For example, if one introduces stimuli that control low rates of behavior problems throughout the day (e.g., Touchette et al., 1985), then the methodology ensures that there are no periods of time available during which one can assess stimulus generalization. Another issue concerns the assessment of stimulus generalization following the use of setting events. Fol-

lowing a period of exercise (a setting event), one may observe a reduction in behavior problems (e.g., Baumeister & MacLean, 1984). If one conceptualizes the situation involving the exercise period as one stimulus complex and the period following exercise as a different stimulus complex, then behavior reductions observed in the second stimulus complex could be viewed as an example of stimulus generalization. On the other hand, if one views exercise as the treatment and the period following exercise as the test of that treatment, then any behavior reductions following exercise are the direct result of treatment rather than an example of stimulus generalization. The methodological and conceptual issues just outlined have not been analyzed as yet in the literature involving stimulus-based intervention.

To conclude, there have been only a small number of studies that have systematically addressed the issue of stimulus generalization. Of those studies that do address the issue, some find strong evidence for generalization (e.g., Durand, 1984; Mace et al., 1983) whereas others find weak effects (e.g., Day et al., 1988). Ultimately, the failure to find generalization effects may not often be a major clinical drawback. This is because once an effective treatment has been identified, it is usually possible to introduce that treatment into any desired situation that does not already give evidence of stimulus generalization (Stokes & Baer, 1977), thereby promoting more widespread gains. Generalization failures may, however, constitute a major clinical drawback in those cases in which programming treatment across situations is unduly time consuming, costly, or personnel intensive.

Response Generalization

The major issue to be considered here concerns whether a decrease in a specific behavior problem following treatment is accompanied by changes in other aspects of an individual's functioning in spite of the fact that these other aspects were not a target of treatment. As was the case for stimulus generalization, few studies report systematic data. Most observations are anecdotal in nature. For example, following the successful use of DRO to eliminate self-injury, Weiher and Harman (1975) noted that the person treated became more vocal and social. Likewise, Carr et al. (1976) observed an increase in laughing, smiling, and talking as the self-injury of one boy diagnosed as schizophrenic decreased following a stimulus-based intervention.

Only two studies were identified, both in the literature on DRO, in which systematic data were taken to demonstrate response generalization effects. Garcia and DeHaven (1975) found that following successful treatment of spitting, there was a 100% decrease in vomiting. Parrish, Cataldo, Kolko, Neef, & Egel (1986) found that following the successful treatment of aggressive behavior, there was a 78%, 109%, and 2225% increase respectively in compliance for the three individuals treated.

At first the lack of data on response generalization may seem discouraging. However, it is important to bear in mind that the entire literature on positive treatment approaches could be legitimately reconceptualized in such a manner that every study we have examined becomes relevant to the issue of response generalization. Specifically, recall that all positive interventions are designed to make socially desirable responses more probable. That is, the behavior that is the target of intervention is some response other than the problem behavior. Thus, in DRC, communication is the target of treatment. In DRI, a physically incompatible behavior is the target of treatment. In an intervention based on setting events, exercise may be the target of intervention. In every case, not only does the target of intervention increase in probability, but the probability of behavior problems may also change (decrease) in spite of the fact that the problem behavior is not directly treated. This outcome constitutes a true example of response generalization, hence the statement that the literature on positive treatments constitutes a systematic exploration of response generalization phenomena.

Of course, it is important that a reduction in behavior problems should be accompanied also by a wide variety of other desirable changes. This idea is sometimes stated in terms of the notion of life-style change (Horner, Dunlap, & Koegel, 1988; Meyer & Evans, 1989; Smith, 1990); that is, the elimination of behavior problems is held to be clinically insignificant unless it allows an individual to function effectively in the wider world of work and recreation and makes possible new opportunities for social interaction in the community. One might also expect that the elimination of behavior problems could be accompanied by qualitative changes in more subjective variables relating to affective expression and sensitivity to others. The definition, measurement, and analysis of these variables constitutes a major research challenge that has yet to be taken up by applied behavior analysts. Successful analyses and clinical demonstrations with respect to these variables would constitute an important step toward social validation. The notion of life-style change is in actuality a call for broad-spectrum response generalization effects of a type that has rarely been reported in the literature even at an anecdotal level. Increasingly, the meaningful treatment of behavior problems will require some demonstration that the alleviation of problems is accompanied by life-style change. At this point we would simply like to note that it may be naive to expect that the elimination of behavior problems will,

by itself, automatically make new opportunities available to the successfully treated individual. More likely, life-style change will require that new competencies be developed in the individual through an array of educational, community-oriented interventions that are applied concurrently with the strategies used to eliminate the behavior problem.

Maintenance

Table 11 shows the data for maintenance of treatment effects following the use of positive approaches. It should be noted that some studies reviewed report maintenance data following the use of a combination of positive and aversive procedures. Since these studies do not permit an assessment of the unique contribution of positive approaches to maintenance, they are excluded from Table 11. Of the 40 DRO studies included in our analysis, only 5 reported data on maintenance. These studies involved a total of 6 subjects who exhibited 92 to 100% suppression of behavior problems at follow-ups ranging in duration from 2 to 12 months. Of the 14 DRI studies reviewed, 5 reported maintenance data. These studies involved a total of 6 subjects who exhibited 95 to 100% suppression at follow-ups ranging from 6 to 15 months. Of the 18 skills acquisition studies analyzed, 6 reported maintenance data. These studies involved a total of 8 subjects who exhibited 60 to 100% suppression at follow-ups ranging from 30 days to 9 months. One subject was worse at follow-up (i.e., 9% increase in behavior problems). Of the 24 studies reviewed involving stimulus-based intervention, only 2 reported maintenance data. These studies involved a total of 2 subjects who exhibited 84% and 98% suppression respectively at follow-ups of 10 days and 12 months.

Clearly, only a small number of studies in the literature report maintenance data. Of the 96 studies reviewed, 18 studies, or 19% of the sample, presented systematic follow-up data. Nonetheless, the research demonstrates that for all four categories of treatment, one or more studies can be found in which the target behavior was suppressed 90%

Table 11
Maintenance of Treatment Effects for Positive Approaches

Procedure	Study	Subjects	% Suppression of target behavior
DRO	Barman (1980)—s*	1	100% at 12 mo.
	Frankel, Moss, Schofield, & Simmons (1976)—s	1	97% at 100 days
	Luiselli, Colozzi, & O'Toole (1980)—s	1	92-97% (depending on setting) at 2 mo.
	Luiselli, Myles, Evans, & Boyce (1985)—w*	2	S1: 100% at 5 mo. S2: 93% at 3 mo.
	Luiselli & Slocumb (1983)—w	1	94% at 34 weeks
DRI	Friman, Barnard, Altman, & Wolf (1986)—s	1	95% at 15 mo.
	Mace, Kratochwill, & Fiello (1983)—s	1	100% at 8 mo.
	Saposnek & Watson (1974)—s	1	100% at 6 mo.
	Smith (1987)—w	1	97% at 12 mo.
	Steege, Wacker, Berg, Cigrand, & Cooper (1989)—w	2	S1: 100% at 6 mo. S2: 100% at 15 mo.
Skills acquisition	Billingsley & Neel (1985)—w	1	90% at 30 days
	Brawley, Harris, Allen, Fleming, & Peterson (1969)—w	1	95% at 3 mo.
	Durand & Kishi (1987)—w	5	S1: 87% at 1 mo. S2: 100% at 1 mo. S3: 9% incr. at 1 mo. S4: 98% at 9 mo. S5: 68% at 9 mo.
	Gardner, Cole, Berry, & Nowinski (1983)—s	2	S1: 100% at 6 mo. S2: 100% at 6 mo.
	Shapiro & Klein (1980)—w	3	S1: 88% at 2 mo. S2: 100% at 2 mo. S3: 60% at 2 mo.
	Slifer, Ivancic, Parrish, Page, & Burgio (1986)—w	1	85% at 3 mo.
Stimulus-based	Jackson, Johnson, Ackron, & Crowley (1975)—w	1	84% at 10 days
	Touchette, MacDonald, & Langer (1985)—s	1	98% at 12 mo.

*s = strong criterion; w = weak criterion

or more from baseline levels. Furthermore, for all treatment categories, one or more studies can be found demonstrating maintenance effects of 9 months or more. There is thus a data base, though not yet an extensive one, that supports the assertion that positive approaches can produce long-term treatment gains.

The significance of a strong (s) versus weak (w) criterion for maintenance as shown in Table 11 requires some comment. Recall that a strong criterion means that no elements of the original treatment are present during the follow-up period. A weak criterion, on the other hand, means that at least some elements of the original treatment are retained in follow-up. The first issue to be addressed concerns whether a strong criterion is inherently superior to a weak criterion. In the case of DRO, a strong criterion is arguably better. The reason for this statement is that a DRO, particularly one involving a short treatment interval, requires extensive monitoring and may impede the carrying out of other activities including academic and vocational instruction. Thus, eventual termination of DRO is essential if the individual is to function more normally in the school and community. In contrast, in the case of skills acquisition, a strong criterion may in fact be counterproductive. Consider communication training as an example. In the study by Durand and Kishi (1987), some students were taught to ask for a break whenever they had worked for a time. As they acquired this communicative response, their aggressive behaviors declined precipitously, ostensibly because such behaviors were escape-motivated (i.e., in lay terms, a way of getting a break) and were now no longer necessary. It is important to stress that part of the treatment involved caregivers honoring the break requests. If requests were not honored, communication would not change the individual's living situation in any appreciable way and therefore one could expect continued high rates of behavior problems. A strong criterion implies that all aspects of the treatment procedure, including caregiver responsivity, be discontinued. In the present case, this approach would almost certainly produce an increase in behavior problems. Thus, a strong criterion is largely irrelevant to evaluating maintenance following skills acquisition. The continued strengthening and expansion of newly acquired skills (albeit involving a lower level of prompting and other instructional strategies) is frequently essential during the follow-up period and beyond.

The second issue to be addressed concerns the significance of successful maintenance following the complete withdrawal of treatment (strong criterion). If DRO, for example, is completely withdrawn and strong maintenance effects are reported (e.g., Barman, 1980; Luiselli, Colozzi, & O'Toole, 1980), to what extent can it be said that DRO per se was responsible? Incidentally, the same issue presents itself in the case of aversive treatment when, for example, electric shock has been discontinued for a year and maintenance is then assessed. There is frequently an implicit assumption that a given treatment, positive or aversive, somehow influences behavior long after the treatment itself has been discontinued. At present, however, there is no coherent theory as to how this action-at-a-distance model works. More plausible is the assumption that, regardless of the treatment used, elements of the posttreatment environment are critically related to the long-term facilitation or inhibition of treatment effects. The field as a whole has ignored this important issue by its failure to delineate in a systematic and empirical fashion the elements of the posttreatment environment thought to be important in maintenance. Until such studies are carried out and the mechanisms underlying the process are identified, maintenance effects, though sometimes achieved, will seldom be explicable or predictable.

VI. RECOMMENDATIONS

1. There is a need to encourage the further development and more widespread use of functional analysis and hypothesis-driven intervention as an approach for systematically selecting relevant treatments from the array of all possible treatments. With few exceptions, the literature illustrates a pattern in which clinicians and researchers alike select treatments without providing a coherent rationale by which such selections are justified. That is, treatment selection is typically not based on a knowledge of the variables controlling severe behavior problems. The data reviewed suggest that approaches more directly tied to functional analysis (e.g., skills acquisition, stimulus-based intervention) are somewhat more likely to produce favorable outcomes. This fact provides further incentive for emphasizing the role of functional analysis in treatment planning.

2. It may be useful to combine several positive approaches in order to produce a comprehensive treatment intervention. To date, only a few studies have employed this strategy (Berkman & Meyer, 1988; Donnellan, LaVigna, Zambito, & Thvedt, 1985; Heidorn & Jensen, 1984). In every case, outcome data were encouraging. The two concerns that argue most strongly in favor of combining positive approaches involve the issue of crisis management and the likelihood that problem behavior may be multiply motivated. In most clinical cases, both of these issues have to be addressed. Crisis management requires procedures that work quickly. In this regard, stimulus-based intervention may be an important part of treatment. Multiple motivation means that for a single individual, behavior problems may be maintained by escape, tangibles, attention-seeking, or sensory variables, depending on the context in which the behavior occurs. Thus, different treatments (e.g., DRC, compliance training, manipulation of setting events) must be brought to bear on the various aspects of the problem behavior. Thus far, the design of treatments that systematically address the array of motivational and antecedent factors that commonly operate in individual cases has been largely ignored in favor of intervention oriented to solving some particular aspect of the wider problem.

3. The field needs to shift its focus from crisis management, where the emphasis has been for 25 years, to considerations of long-term treatment. Even when a crisis is successfully managed, there is still a question of how to ensure that treatment gains will maintain. Otherwise, a recurrent cycle of crises may ensue. There need to be incentives that encourage researchers to explore and identify those aspects of the posttreatment environment that facilitate maintenance.

4. The nature of the dependent variable in research on severe behavior problems needs to be expanded from the traditional focus on frequency, rate, and duration to a new and wider focus involving considerations of severity, conditional probability, and life-style changes, including those pertaining to interpersonal and affective variables.

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